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THE IMPORTANCE OF SELECTED AUDIENCE AND FILM CHARACTERISTICS
AS DETERMINERS OF THE EFFECTIVENESS OF INSTRUCTIONAL FILMS.
FINAL REPORT.

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THIS PROJECT EXPLORED (1) INDIVIDUAL DIFFERENCES AMONG LEARNERS WHICH MAY BE DIFFERENTIALLY RELATED TO FILM LEARNING VERSUS CONVENTIONAL OR "LIVE" LEARNING, AND (2) INDIVIDUAL DIFFERENCES AMONG INSTRUCTIONAL FILMS WHICH MAY BE RELATED TO THEIR INSTRUCTIONAL EFFECTIVENESS OR TO IMPORTANT LEARNER CHARACTERISTICS. TWO SEPARATE STUDIES WERE CONDUCTED. THE FIRST STUDY USED THE SIMILAR EXPERIMENTAL DESIGN OF THE 1961 TENDOM STUDY. THE SECOND STUDY WAS PLANNED AS A FACTOR ANALYSIS. THE FILMS, ORIGINALLY PRODUCED BY TENDOM (1961), AND THE ACCOMPANYING PRINTED SCRIPTS WERE REVIEWED INTENSIVELY TO LOCATE THOSE FILM PRODUCTION VARIABLES WHICH APPEARED TO VARY AMONG THE FILMS IN THE SERIES AND WHICH COULD BE QUANTIFIED SATISFACTORILY AND MEANINGFULLY AS INDIVIDUAL DIFFERENCES AMONG THE FILMS. THREE INDIVIDUALS PARTICIPATED IN THE ANALYSIS. CONCLUSIONS FOR THE FIRST STUDY SEEMED TO INDICATE THAT PERSONAL CHARACTERISTICS OF LEARNERS DETERMINE, TO A SIGNIFICANT EXTENT, THE AMOUNT OF LEARNING DERIVED BY INDIVIDUAL MEMBERS OF THE AUDIENCE IN A GIVEN LEARNING SITUATION. RESULTS OF THE STATISTICAL ANALYSIS ARE SUMMARIZED IN SYMBOLIC FORM. THE SECOND STUDY CONCLUSIONS INDICATED THAT, AFTER FACTOR ANALYSIS OF 34 VARIABLES, SIX FACTORS WERE PROPOSED TO ACCOUNT FOR THE VARIANCE OBSERVED. THEY ARE (1) AUDIOVISUAL COMPLEXITY, (2) AUDIOICONICITY, (3) VIDEO ICONICITY, (4) TEMPORALITY, (5) ARTIFICIALITY, AND (6) INTERNAL REPETITION. SIX HYPOTHESES WERE SUGGESTED BY THE CLUSTERS OF VARIABLES. EVIDENCE SHOWED THAN AN INSTRUCTIONAL FILM, WHILE IT IS INHERENTLY AN EXTREMELY COMPLEX COMBINATION OF PRODUCTION CHARACTERISTICS, CAN BE ANALYZED MEANINGFULLY AT AN ELEMENTAL, PHYSICALISTIC LEVEL. (HB)

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FINAL REPORT
January 1, 1963

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Richard E. Snow
Audio Visual Center
Purdue University
Lafayette, Indiana

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PREFACE

The research project reported herein was conducted in two parts and thus two separate studies have been presented within one cover. Only the Introduction, Directions for Further Research, List of References, and Appendix sections are common to both investigations. Conclusion sections for Study One and Study Two may be found in Chapters VIII and XII, respectively. This organizational scheme, while not allowing a combined summary, has simplified the presentation of methodology and results considerably. It is hoped that the reader's task has also been reduced.

The author is indebted to a number of individuals who contributed to the formulation and execution of the research and to the preparation of this final report. Profs. J. Tiffin and W. F. Seibert served in an advisory capacity, offering many helpful ideas and suggestions to all phases of the project. Prof. B. J. Winer assisted with planning of the statistical analysis for Study One. Mr. C. S. Pryluck contributed some useful ideas to the discussion for Study Two. Profs. J. H. Moriarty and L. D. Miller provided much needed administrative guidance and support. Profs. D. J. Tendam and R. R. McLeod allowed the necessary alterations and inclusions in their physics film evaluation experiment and the introductory physics course in which it was carried out. Prof. D. F. Moses and Messrs. R. E. Wolf, J. H. Glade, W. M. Peffley, R. E. Nahory, and J. H. Reuszer contributed much time and effort as expert

judges of the films. Mrs. Alice Paschke and Mrs. Jean Mortimer served admirably and cooperatively as film analysts. Mrs. Judy Myers provided her skill and patience in the typing of the manuscript. To these individuals, I gratefully extend my sincerest thanks and appreciation.

Richard E. Snow
West Lafayette, Indiana
January 1, 1963

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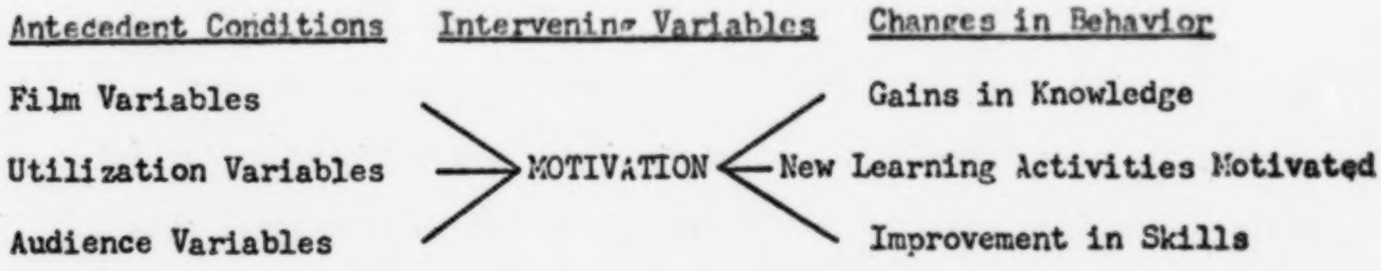
INTRODUCTION

The research literature on the effectiveness of instructional films indicates that films can teach and that, in some cases, they can do so more effectively than other methods of instruction. Because of the actual and potential value of the motion picture as an instructional medium in education, industry, and the military, researchers have been attempting to isolate those factors which determine the extent to which individuals learn from films.

The process of learning from films and the factors of importance in this process have been shown schematically by May and Lumsdaine (1958, p. 8) as follows:


Antecedent Conditions
Intervening Variables
Changes in Behavior
Film Variables
Utilization Variables
Audience Variables
MOTIVATION
Gains in Knowledge
New Learning Activities Motivated
Improvement in Skills

Thus, antecedent variables which have been suggested as determinants of learning from films may be divided into three general classes. Included in the film variables class are all those characteristics of instructional films arising from differences in production techniques and specifications. Among these are; (1) length of the film, (2) density or amount of information per minute of running time, (3) use of attention-gaining devices, (4) extent of interaction between audio and video components, (5) readability of commentary, (6) use of closeups, zooms, and changes in camera angle, (7) inclusion of introductions and summaries, and (8) provision for student participation. Utilization variables include; (1) pre- and post-film treatment such as class discussion, (2) repetition of showing, (3) integration of film with other instructional material, (4) time of day and place of showing, (5) quality of projection, (6) viewing distance, and (7) viewing angle. The class of audience variables would include all individual differences among viewers which might be related to learning from films.

While production and utilization variables have long been acknowledged as important in affecting the amount and kinds of learning arising from films, audience variables have often been ignored. Hoban recently commented (1960, p. 105) that, despite the early observation of individual differences in response to films by Lashley and Watson (1922), "...the importance of audience characteristics as determinants of learning from films has only recently come to be appreciated and forcefully articulated." The fact that this importance has been "appreciated and forcefully articulated" may be documented by the following quotations from two recent reviews of the instructional film research literature.

> "It is often assumed that a motion picture has the same effect on every individual of the audience. Actually, there is a wide range of individual differences in any audience; the more heterogeneous the audience, the greater the range. Moreover, the range of these differences increases as the individuals in the group approach maturity. These differences in individual characteristics cause people to respond differently to instructional films." (Hoban and Van Ormer, 1950, p. 9-4)

> "The earlier concept of the audience as a kind of atomistic mass, subject to persuasion or instruction by powerful communication mediums [sic], is being viewed with increased skepticism. We seem to be gradually approaching the position taken by Carpenter [1954] when he expressed the opinion that the effects of film instruction, within certain limits, depend more upon the characteristics of the perceivers, individuals and audiences, than upon the elemental variables within the films themselves." (Allen, 1960, p. 122)

To the extent that individual learner abilities and characteristics are important in learning from instructional films, their effects must be fully understood. Such an understanding is of practical importance in that it permits these variables to be used to advantage or, at least, controlled in the development and evaluation of instructional films and in the selection of individuals who will profit from those films. It is of theoretical importance also, if these abilities and characteristics relate to a general ability to learn or if film learning and conventional learning involve different abilities and characteristics.

Although there is now a body of research literature dealing with the relationships between audience variables and film learning alone, few attempts have been made to determine whether there are abilities or characteristics involved in film learning which are either not required in conventional learning situations or which are involved in conventional learning to a differential extent. The term "film literacy" has been used to refer to hypothesized special abilities which are unique to film learning but no precise definition of the term has been accepted and very little evidence for the existence of these abilities has been offered. Further, if it can be shown that general audience characteristics affect film learning and conventional, "live" learning differentially, then the "film literacy" concept may have to be extended to include these effects.

But audience variables should not be studied in isolation. Clearly, there exists the possibility of interactions among variables in the three classes of antecedent conditions. Understanding audience prerequisites to efficient film learning seems thus to require understanding of the effects of variables in the film and its use.

Film production characteristics might be especially important in this regard. Hoban and Van Ormer (1950) have suggested that "film literacy" may involve the ability to interpret film techniques such as dissolves, montages, etc. Other more general audience characteristics might also be related to structural aspects of films. Further, within the limits of specific objectives and utilization in a given instructional situation, film effectiveness has been shown to depend, to a significant extent, on production variables alone. May and Lumsdaine (1958, p. 317) have stated that:

> "It is important to recognize that certain improvements that can be built into a film...offer considerable promise for further increasing their instructional value. These include clear visualization adapted to the pupils' level of prerequisite information, verbal clarification of visuals, simplification of language, and attention to maximizing pictorial cue and verbal response-provoking factors..."

Much previous research has been devoted to comparisons between films differing in terms of one production characteristic only. However, there is a large number of physical dimensions along which films may differ from one another and many of these may be correlated. This structural complexity suggests another approach to research in this area which has not been exploited; one aimed at discovering underlying communalities in the "anatomy" of existing films rather than the experimental manipulation of individual film variables. As a means of relating film characteristic profiles to criteria of effectiveness or to indices referring to audience variable effects, or simply as a description of the production philosophy directing a specific instructional film's construction, factor analysis of the physical structure of films would be useful.

Thus, there appears to be need for research designed to explore (1) individual differences among learners which may be differentially related to film learning vs. conventional, "live" learning and (2) individual differences among instructional films which may be related to their instructional effectiveness or to important learner characteristics. It was with these needs in mind that the studies reported herein were conceived and carried out.[1]

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[1] This research was supported by a grant from the U.S. Office of Education under the provisions of Title VII of the National Defense Education Act of 1958.

STUDY ONE

AUDIENCE CHARACTERISTICS

CHAPTER I

BACKGROUND AND OBJECTIVES

Previous Research

As a preliminary step in this investigation, a relatively detailed review of past literature was undertaken and completed. The purposes of this review were (1) to identify the major learner variables which had been previously investigated and (2) to isolate some of the problems and shortcomings evident in earlier work in this field. The complete review has not been included in the text of this report however. Rather, it is presented as Appendix A. Only a brief summary of its findings seems appropriate here.

The studies summarized in Appendix A, when taken together, do provide evidence for the existence of some variables, and suggestions and hypotheses concerning others, which appear to act within the individual viewer to influence his learning from instructional films. Which of these variables are the most important and what combinations would offer the maximum prediction in a given film learning situation is not known. It is doubtful whether each of these variables would be found to be factorially pure. Further, it is doubtful that together they exhaust the universe of potentially important variables.

Variables which have been shown to be related to factual film learning in at least one instance are:

1. Age. This variable is positively related to film learning

up to age 20 but it is difficult to determine the extent to which this relationship is due to intellectual and educational factors.

2. Sex. Sex differences appear to act indirectly upon film learning by influencing preferences and interests.
3. Educational level.
4. Intelligence. IQ scores and general intelligence test scores are positively correlated with film learning. Specific aspects of mental ability which have been identified as important are: Verbal Comprehension, including reading ability and vocabulary size; General Reasoning; Spatial Orientation; Spatial Visualization.
5. Previous knowledge of the subject matter presented.
6. Past experience with, or practice in viewing, instructional films.
7. Past experience with entertainment films and movies. This finding is based on group data only and evidence using individual data is not available.
8. Attitude toward the subject matter presented via instructional film. As conceived here, this variable would include the perceived usefulness of the subject matter.
9. Induced or situational anxiety. Although differences in level of induced anxiety are positively related to film learning, anxiety as a personality trait is not correlated with film learning.

Variables which have been hypothesized as related to factual film learning but which lack sufficient empirical support are:

10. Attitude toward the instructional film medium. Included in this variable would be the credibility or functional dependability of the medium.
11. Attitude toward entertainment films and movies or the intrinsic appeal of the movies.
12. Spectator attitude or entertainment set.
13. Preferences for and interests in particular films or types of films.
14. Personal involvement in the film or identification with the characters and situations presented.
15. Persuasibility. With films designed to alter opinions, this variable has been shown to be negatively related to the extent of an individual's self esteem.
16. Socio-economic status or military rank. This variable could also include social role aspirations and valuations.
17. Physiological response to film.
18. Familiarity with cinematic techniques.

Three general problems exist in many of the research studies on which the variables listed above are based. These deficiencies must be considered in deciding the generality of the findings reviewed and in formulating further research in this area.

Criterion problems, which often plague psychological research in other areas, are no less apparent in research on instructional films. Many investigators have employed an objective achievement test on the material presented by film to measure the amount learned. Although this procedure is simple and straight-forward, it has been justly criticized on the grounds that it measures all relevant learning up to the time of administration rather than learning arising from the immediately preceding film presentation alone. Other researchers have insisted that a gain score between pre-film and post-film tests or between experimental and control groups be used. While it is conceded that previous knowledge of the material should be controlled by some means, gain scores do not seem to offer the best solution since, as differences, they are known to be unreliable. They are also affected adversely when computed from tests including too few difficult items. Special gain scores have been developed which are not affected by differences in the amount of gain possible for subjects differing in baseline scores. However, the sampling distributions of error for these indices are not known (Hovland, Lumsdaine, and Sheffield, 1949; May and Lumsdaine, 1958). Regardless of which method of criterion measurement is to be considered superior, results from studies using different criteria are difficult to compare.

In the view of this writer, the important questions for research with respect to learner characteristics in relation to film learning, do not concern film learning per se. Too much research has been devoted to the study of film learning in a vacuum. Hoban (1960, pp. 105-106) has stated that "Two significant parameters of audience composition on which there is little room for disagreement are age and amount of formal education...In general, a difference in amount of learning from films can be detected between elementary and high school students, and within as few as three grades in the elementary school." This statement is true but it is also true with respect to conventional learning situations.

Unless the similarities and differences between film learning and conventional learning in terms of audience variables are determined, little additional knowledge has been obtained. The important question is not so much whether intelligence or some other variable is correlated with film learning but whether this correlation is different from that found with conventional learning of the same material. Further, it would be important to determine what relationships exist between learner variables which have in common the fact that they influence film learning and conventional learning to a differential extent.

A third deficiency in previous research is implied above. Many of the studies reviewed have been concerned with one learner characteristic and its relationship to film learning. Additional understanding of the effects of audience characteristics might be obtained from the study of all pertinent variables in the same learning situation and the determination of the relationships among them in that situation.

Objective of the Study

The major objective of this research was to investigate the effects of audience characteristics on factual learning from instructional films in comparison with learning from conventional, live presentations of the same material. The study was planned to include a large and fairly representative sample of those learner variables which previous findings and hypotheses have suggested as important influences on film-mediated learning. By studying many learner variables and both film and conventional presentation conditions in the same learning situation, it was hoped that a significant extension of previous research might be accomplished.

Answers to the following questions were sought:

1. What personal characteristics and abilities of the learner, if any, are differentially related to film learning vs. conventional learning?
2. How are these personal characteristics related to one another?

CHAPTER II

METHODOLOGICAL PERSPECTIVE

The investigation carried out and reported in this paper was an outgrowth of an earlier research project directed by Tendam (1961). The series of films, the subjects, and the criterion data originally used in the earlier study also form the basis for this research. A summary of that study is thus included here.

The Tendam Study

The major objective of the Tendam study was to determine whether motion picture films of selected physics demonstration experiments were as effective instructionally as demonstrations actually performed by the lecturer in the classroom. A series of 20 films was developed, each demonstrating a specific experiment in physics and the physical principle resulting therefrom. The films were organized into 15 demonstrations and were presented to students in the introductory physics course at Purdue University on 15 different class days during the spring of 1960 and again in the spring of 1961.[2]

At the beginning of each semester, students were randomly assigned to one of the two experimental sections of the course and were further randomly assigned to seats in one of four viewing distances in each section defined as the near quarter, the medium-near quarter, the medium-far quarter, and the far quarter of the 280-seat lecture hall. The two sections met for class in the same room during adjacent hours of the same day with the same instructor. Both sections received the same short quizzes on demonstration content, administered immediately after each demonstration, and the same hourly examinations on the entire course content, administered five times during the semester at approximately three-week intervals. In 1960, the 3:00 p.m. section received filmed demonstrations. The 4:00 p.m. section received the same demonstrations actually performed in class by the lecturer. In 1961, when the experiment was repeated with different subjects, the temporal order of the two treatment conditions was reversed.

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[2] In the spring of 1961, the portion of the study on which this research is based, only 14 demonstrations were used. The fifteenth demonstration was dropped due to an administrative decision to excuse most students from class on the day that this last film was to be shown.

The two independent variables (filmed vs. "live" demonstrations; four levels of viewing distance) were used in analyses of covariance with a 40-item multiple choice achievement pretest acting as covariate. Dependent variables for these analyses were (1) total score over the 15 quizzes, (2) total score over the five hourly examinations, and (3) total score over five special hourly examination questions dealing specifically with material presented in one or more of the demonstrations.

Results of the statistical analyses supported the conclusion that filmed presentation is "...at least as effective, and perhaps more effective instructionally, than the conventional method of presentation" and that "Student achievement...is independent of the distance (up to 60 feet) between the student and the lecture demonstration experiments... irrespective of whether the experiments are performed by the lecturer or are presented on film" (Tendam, 1961, pp. 36-37). One possible explanation offered for some lack of agreement between the 1960 and the 1961 results was that the 1960 group "...contained noticeably fewer able students than did other classes of the past five years" (Tendam, 1961, p. 39). It was suggested that further research might investigate the relationship between student ability and film learning.

The Tendam study afforded a unique opportunity to accomplish the objectives of the present research. Class time was made available during the 1961 portion of the Tendam experiment to collect the additional data necessary to carry out this investigation.

Experimental Design

Independent Variables. The 1961 portion of the Tendam study provided two randomly constituted groups of subjects; one which had received the filmed demonstration treatment, and one which had received the live demonstration treatment. This two-level factor (Factor A) became the first independent variable in the design of the present study. A second independent variable was obtained by subdividing the above two groups into thirds according to scores on the physics achievement pretest originally used as covariate in the Tendam study. This subdivision provided the three-level independent variable of previous knowledge of the subject matter to be taught (Factor B). This variable was included in the design primarily as a control. Also, it was considered quite possible that some personal characteristics might affect learning only within certain segments of the previous knowledge continuum. The previously used viewing distance variable was disregarded in this design.

Six groups of subjects resulted from the establishment of the above two independent variables. Using a measure of any given learner characteristic (Factor C), each of these six groups could then be divided further into the high 25 per cent, middle 50 per cent, and low 25 per cent of the distribution of scores on that measure. This division was made for 14 different personal characteristics measured in this study. Each personal variable was used in turn to produce a 2 X 3 X 3 factorial design in which the analysis of variance (ANOV) could be applied using one or more dependent variables to evaluate the effect of that particular personal variable (see Table 1).

The personal characteristics chosen for this investigation are listed below, together with a description of the method of measurement used for each variable.

1. Attitude toward instructional films (AIF).
2. Attitude toward entertainment films (AEF).
3. Attitude toward physics (AP).

Each of the attitude variables was measured by a six-item Likert-type scale which consisted of three favorable and three unfavorable statements. The attitude statements were obtained, with some modification, from scales originally developed by Seibert (1958), Kelley (1934), and Silance and Remmers (1934). The respondent indicated the extent of his agreement or disagreement with each statement by marking the appropriate point on a five-point scale. The attitude scales were administered to all subjects on the first class day of the spring semester, 1961, as part of the Physics Personal Inventory (see Appendix B).

4. Ascendancy (A-GPP).

Table 1

Factorial Design for the Analysis of Variance

		Physics Achievement Pretest					
		High 33%(b_3)		Middle 33%(b_2)		Low 33%(b_1)	
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)
Personal Characteristic	High 25%(c_3)						
	Middle 50%(c_2)						
	Low 25%(c_1)						

5. Responsibility (R-GPP).
6. Emotional Stability (E-GPP).
7. Sociability (S-GPP).
8. Total Score (T-GPP).

Scores on each of the five personality variables were obtained from the Gordon Personal Profile according to the scoring formulae prescribed by Gordon (1953). Constants were then added to these raw scores to eliminate negative values. The instrument was administered to all subjects during the last two weeks of the semester.[3]

9. Numerical aptitude (NA).
10. Verbal aptitude (VA).
11. Academic achievement (AA).

Scores on each of the above intellectual variables were obtained from records maintained by Purdue University. The aptitude scores derive from the Purdue Mathematics Training Test and the Purdue Proficiency Examination in English, respectively, which are administered to all entering freshmen. Academic achievement was measured using the grade point average obtained by each student for the semester preceding that in which the experiment was carried out. For the majority of subjects, who were second-semester freshmen, this index represented their achievement in the first semester of their college work.

12. Past experience with instructional films (PXIF).
13. Past use of Purdue Film Library (PUFL).

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[3] Since sufficient time was not available in the large lecture sections of the course, the administration was accomplished in the recitation groups (small subdivisions of approximately 30 students each). Every effort was made to standardize the administration procedure among these groups of subjects.

14. Past experience with entertainment films (PXEF).

Data concerning subjects' past experiences were collected using two different methods. The Physics Personal Inventory, administered at the beginning of the semester, included a question pertaining to each of the above three past experience variables (see Appendix B). Subjects responded by checking the frequency category appropriate to their previous use of, or attendance at, films and movies. Since the definition of terms such as "frequently" might be expected to differ among the subjects however, a more precise method of measurement was sought. At the end of the semester, questions requiring self-reported frequencies of use were administered (see Appendix B). Because this second measurement was accomplished after the treatment conditions had been applied during the semester, it was felt that the question concerning past experience with instructional films could not be readministered. Therefore, in the analyses that follow, PXIF has been measured using the categorical frequency questions administered at the beginning of the semester while PUFL and PXEF are based on the self-reported frequencies collected at the end of the semester. A comparison of the data obtained using the two forms of questions for PUFL and PXEF may be found in Tables 25 and 26, Appendix B.

Some information is available concerning the reliability of most of the measures used as independent variables in this investigation. For the attitude variables, reliability estimates were computed by the split-half (odd vs. even) method using data from 415 subjects. Corrected by the Spearman-Brown formula, these estimates ranged from .80 to .82. Reliabilities for the personality scales, estimated using split-half, Kuder-Richardson, and test-retest methods, have been reported by Gordon (1953) as ranging from .74 to .95 for college students. For the aptitude measures, Kuder-Richardson estimates ranging from .88 to .92 have been found (Wykoff, McKee, and Remmers, 1955; Keller, et al., no date). Kuder-Richardson reliabilities for the physics achievement pretest were found to be .51 and .53 but, since this test was not intended to be unidimensional, these values are underestimates (Tendam, 1961). Reliability data for the past experience variables and for semester grade point average were not obtainable.

Dependent Variables. During the course of the semester, each film or live demonstration was immediately followed by a short quiz on the material covered. These quizzes were objective in nature, requiring either a multiple-choice response or a short, constructed answer, and were planned for administration within a five minute time limit. A quiz total score was computed for each student as the sum of the scores of all quizzes administered during the semester, absences being regarded as zero scores. After multiplication by a constant, this score became a part of the students' final grade for the course. The quiz total score was used as the first dependent variable and may be considered a measure of immediate recall.[4]

Before this measure could be accepted for use as a dependent variable however, one question required resolution. It was decided that subjects who had missed three or more quizzes should be dropped from the experiment but that, if possible, those missing only one or two quizzes should be retained. Since zero scores were therefore used to indicate both absence and complete failure on a quiz, it was necessary to determine what effect, if any, this procedure had on the distribution of total scores. Quiz total scores for the 134 individuals who had missed one or two quizzes were recomputed as an average of those quizzes completed rather than as a sum of all 14 quizzes. The Pearson product-moment correlation between the two scoring formulae was found to be .98. Thus, there was essentially no change in the rank order of subjects due to this effect. Also of interest was the possibility that the number of subjects missing quizzes whose variances deviated from that of the majority of quizzes was disproportionate between the film and live treatment conditions. Among 134 subjects missing one or two quizzes, it was found that 14 film group subjects missed one of the three largest variance quizzes while 13 live group students missed these quizzes. Of the film group subjects, 5 missed one of the two smallest variance quizzes while 7 live group students missed these quizzes. On the basis of these data, it was concluded that subjects missing one or two quizzes could be retained in the sample and that the original scoring formula could be used without substantially affecting the results of the study.

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[4] In this report, the term "recall" is not used in its strictest definition. Since these tests required both constructed response (strict recall) and multiple-choice response (recognition), the term should be taken to mean only "repetition of material previously learned". (See English and English, 1958, p. 443.)

The second dependent variable might be considered a measure of delayed recall. Special questions dealing specifically with material presented in the demonstrations were included in each of the five hourly examinations given during the course. These questions were objective in nature and dealt only with demonstrations presented in the previous three-week period. The sum of the scores on these questions made up the second criterion measure. It must be emphasized however that this variable is in no way equivalent to that obtained from the quizzes. Thus, immediate and delayed responses have been collected using different instruments and comparisons of results between the two criteria should be undertaken with caution.

For the past experience factors, one other criterion measure was employed. It was considered quite possible that the series of 14 filmed demonstrations might itself constitute an increase in past experience with films. If past experience is important in subsequent learning from films then film group subjects should have improved as the semester proceeded. The quizzes were thus divided into three stages, quizzes #1 through #5, quizzes #6 through #10, and quizzes #11 through #14, and each of the three resulting quiz subtotal scores was used as the dependent variable in a separate ANOV. Although it was recognized that scores on different quizzes or sets of quizzes were not comparable, it was felt that any differences between the results of the analyses using these scores as dependent variables could be meaningfully interpreted.

No reliability estimates for the criterion variables were available. However, from data collected during a previous use of the tests (i.e., the 1960 portion of the Tendam study), computation of individual quiz and examination intercorrelations was possible. For the 14 individual quizzes, an average intercorrelation of .11 was obtained while for the quiz subtotal scores, $\bar{r}$ was found to be .11, .11, and .12. An $\bar{r}$ of .20 was computed for the 5 individual special exam question scores although, for these measures, some slight changes were made in the questions between the 1960 and the 1961 administrations. The correlations on which these averages are based were originally calculated for film and live conditions separately using 116 film group students and 102 live group students. The individual tests are probably not of equal difficulty nor are the intercorrelations among them equal. They were not designed to be related to one another. Although application of the Spearman-Brown formula is therefore not completely appropriate, it was felt that a very rough estimate of reliability for the total score criteria might be obtained through its use. Thus the coefficients, corrected for the number of individual tests included in the total scores, were found to be .66 for the quiz total score, .55 for special exam question score, and .37, .38, and .34 for the first, second, and third quiz subtotal scores, respectively. Unfortunately, it was not possible to incorporate the means for more appropriate reliability estimation into the administration of the introductory physics course.

Statistical Treatment. The 14 personal characteristic variables originally constituted 14 ANOVs. Since two dependent variables were available this doubled the number of ANOVs which could be executed, making a total of 28 analyses. Also, the past experience variables could each be considered in each of three stages of practice within the course. Thus, 37 ANOVs could be carried out.

The experimental design chosen for this investigation has been used in successive ANOVs which differ only in terms of the independent variable appearing as Factor C. Therefore, tests of the main effects of Factors A and B and the interaction effect AB were repeated in each analysis. These repetitive tests, when applied using the same dependent variable, would be expected to differ in outcome only due to differences in the number of subjects included in each analysis. The presentation of the results has placed primary emphasis on tests of the effects of C, AC, BC, and ABC.

Due to the existence of unequal cell frequencies in the analyses, the procedures of unweighted means analysis were used exclusively. Drop-outs from the course appeared to be random and unrelated to the treatment conditions. Missing data on various independent and dependent variables were apparently unrelated to the treatment conditions also.

The chi-square statistic was used to test the assumption that the groups of subjects in each cell represented independent samples from the same population. Since the film group vs. live group breakdown had been accomplished randomly, chi-square was applied only to the 3 X 3 table representing previous knowledge of physics (Factor B) X personal characteristic of the learner (Factor C).

Bartlett's test of homogeneity of variance was also computed for each of the 37 three-fold tables. The results of these tests were not used as bases for modifying the analyses, however, since the F statistic is considered robust with respect to moderate departures from homogeneity and since the heterogeneous cells were not generally involved in the comparisons between individual cells.

The results of the chi-square tests and the Bartlett's tests may be found in Appendix C, Tables 27 and 28, respectively. The outcomes of these tests have been referred to in the following chapters only where they have resulted in rejection of the hypothesis of no difference at the .01 level of significance.

As an aid to interpretation and discussion of the results of the investigation, those independent variables whose effects were found to be statistically significant were intercorrelated. Together with the criterion measures, the resulting matrix of intercorrelations was then factor analyzed in order to interpret the relationships among these variables more parsimoniously. The methods and procedures used in this analysis are discussed in a later section of this paper.

Description of the Sample

A total of 527 subjects were originally available from the introductory physics course in 1961. Of these, 42 subjects dropped the course or transferred to another, non-experimental section during the semester. This group consisted of 20 individuals who had been assigned to the film demonstration group and 22 who had been placed in the live demonstration group. Of the remaining 485 subjects, 10 were foreign students who experienced difficulty in completing the Gordon Personal Profile and/or the Physics Personal Inventory, and 38 missed three or more of the short quizzes during the semester. After these 48 subjects were excluded, the final total sample contained 437 individuals of whom 225 had been assigned to the film group and 212 had been assigned to the live group. An additional 21 subjects were lost for the analyses which used the special examination questions as the dependent variable since they had missed one or more of the five hourly examinations. These individuals were divided 12 and 9 between the film and live groups, respectively. For the purposes of the quiz subtotal score analyses, only those individuals who had taken all 14 quizzes could be considered. This necessitated the exclusion of 134 students of whom 64 were film group subjects and 70 were live group subjects. Thus, these additional analyses of past experience variables were based on only 161 and 142 subjects in the film and live groups, respectively.

In Table 2, the sample of subjects has been described using the various biographical characteristics for which data were available. It may be seen from an inspection of this table that the vast majority of the subjects were single male nonveterans who were 17 or 18 years of age and were enrolled in their second semester of freshman engineering.

Table 2

Description of the Total Sample of Subjects (N=437)[5]

Characteristic	Classification	Frequency
School in the University	Engineering	404
	Science, Education & Humanities	26
	Industrial Management	2
	Unclassified	5
Class	Freshman Sem. 1	1
	" Sem. 2	391
	Sophomore Sem. 3	18
	" Sem. 4	25
	Junior Sem. 5	2
Age	17-18 years	310
	19-20 "	80
	21-22 "	20
	23-24 "	15
	25 or more	8
Sex	Male	424
	Female	10
Military Service	Non Veteran	307
	Currently Enlisted	93
	Veteran	9
Marital Status	Single	401
	Married	30
	Widowed or Divorced	1

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[5] The frequencies within each characteristic do not sum to N=437 in every case due to the failure of some subjects to provide complete information.

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CHAPTER III

ATTITUDE FACTORS

Analyses and Results

Three attitude variables were related to each of the two learning criteria by means of the analysis of variance (ANOV). These variables were attitude toward instructional films, attitude toward entertainment films, and attitude toward physics which have been previously designated as AIF, AEF, and AP, respectively.

A summary of the results of the ANOVs using AIF as Factor C appears in Table 3. For the quiz total score criterion, the effects of variation due to the three-factor interaction ABC were found to be significant at the .05 level. To determine exactly where this significance lay, the simple, simple main effects of Factor A at each level of BC were computed and the appropriate _F_ ratios were generated (see Table 4). These tests represent comparisons between film group and live group means within each combination of the levels of previous knowledge of physics and AIF. One of these effects (A at b_1c_1) was significant at the .01 level. Referring to Table 29, which presents the complete table of means for this analysis, the direction of this significant difference was then ascertained.[6] This result indicated that, among individuals in the low previous knowledge

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[6] All tables of cell means appear as Tables 29 through 65 in Appendix C. Although they are referred to in the text only by number, it should be understood that these tables are found in the appendix rather than in the text.

Table 3

Summary of Analyses of Variance for Attitude Toward Instructional Films[7]

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	16.919	1	16.919	1.48
	B (Previous knowledge)	490.692	2	245.346	21.45**
	C (Attitude toward instructional films)	31.438	2	15.719	1.37
	AB	10.951	2	5.476	.48
	AC	15.933	2	7.966	.70
	BC	24.490	4	6.122	.54
	ABC	120.133	4	30.033	2.63*
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{100959.472}{21.898} =$	4610.485	403	11.440	
Special Exam Question Score	A (Film vs. live)	1.289	1	1.289	.31
	B (Previous knowledge)	101.411	2	50.706	12.30**
	C (Attitude toward instructional films)	4.198	2	2.099	.51
	AB	9.041	2	4.520	1.10
	AC	6.498	2	3.249	.79
	BC	14.829	4	3.707	.90
	ABC	10.649	4	2.662	.65
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{32954.253}{20.874} =$	1578.692	383	4.122	

* = Significant at .05 level
** = Significant at .01 level

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[7] The original computations for this and all following tables were carried out using four decimal places. Due to limitations of space, two and sometimes three places are presented. Slight but inconsequential differences might thus appear should values be recomputed using only the data presented.

Table 4

Tests of Simple, Simple Main Effects of Film vs. Live Learning (A) at Each Level of Previous Knowledge of Physics X Attitude Toward Instructional Films (BC)

Source of Variation	df	MS	F
A at b_3c_3	1	11.672	1.02
A at b_3c_2	1	3.403	.30
A at b_3c_1	1	19.030	1.66
A at b_2c_3	1	.091	.01
A at b_2c_2	1	.249	.02
A at b_2c_1	1	6.641	.58
A at b_1c_3	1	21.292	1.86
A at b_1c_2	1	16.439	1.44
A at b_1c_1	1	85.120	7.44**
Within cell/$\overline{n}_h$	403	11.440	

Where: b_3= high previous knowledge of physics group
b_2= middle " " " " "
b_1= low " " " " "
c_3= high attitude toward instructional films group
c_2= middle " " " " "
c_1= low " " " " "

** = Significant at .01 level

of physics group and the low attitude toward instructional films group, the subjects who viewed the live lecture demonstrations obtained significantly higher scores on the quizzes than did the subjects who received the filmed demonstrations. Results presented in Table 3 have shown that this effect was not found for the special exam question criterion. Cell means for this second dependent variable may be found in Table 30.

The overall main effect of previous knowledge of physics (Factor B) was found to be significant beyond the .01 level in both analyses. The sums of cell means for the levels of this factor in Tables 29 and 30 indicate the marked positive relationship found between previous knowledge and performance on the criterion measures. This finding will recur in all of the analyses to be presented in this and following chapters. Since this variable was included in the design primarily as a control and since its demonstrated general effect on learning is obviously of practical importance, statistical comparisons among individual means associated with its three levels have not been given space in this report.

No other significant effects emerged for the analysis using AIF as Factor C and the quiz total score as dependent variable. This was also the case for the analysis using the special exam question criterion.

The ANOVs using AEF as Factor C and the tables of cell data associated with each of these analyses appear in Tables 5, 31, and 32. Aside from the significant main effect of previous knowledge of physics, which is equivalent to that found in the AIF analyses, no significant differences were noted between the various treatment conditions on either of the dependent variables applied. Tables 6, 33, and 34 show that similar

Table 5

Summary of Analyses of Variance for Attitude Toward Entertainment Films

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	24.636	1	24.636	1.96
	B (Previous knowledge)	476.856	2	238.428	18.93**
	C (Attitude toward entertainment films)	46.001	2	23.000	1.83
	AB	.039	2	.020	.00
	AC	26.102	2	13.051	1.04
	BC	17.471	4	4.368	.35
	ABC	30.512	4	7.628	.61
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{106616.599}{20.697} =$	5151.307	409	12.595	
Special Exam Question Score	A (Film vs. live)	2.732	1	2.732	.60
	B (Previous knowledge)	108.742	2	54.371	11.90**
	C (Attitude toward entertainment films)	1.720	2	.860	.19
	AB	12.240	2	6.120	1.34
	AC	7.933	2	3.966	.87
	BC	23.179	4	5.795	1.27
	ABC	5.997	4	1.499	.33
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{34483.528}{19.453} =$	1772.640	388	4.569	

** = Significant at .01 level

Table 6

Summary of Analyses of Variance for Attitude Toward Physics

Dependent Variable	Source of Variation	SS	df	MS	F
	A (Film vs. live)	14.018	1	14.018	1.17
	B (Previous knowledge)	505.226	2	252.613	21.00**
	C (Attitude toward physics)	20.422	2	10.211	.85
Quiz	AB	2.163	2	1.082	.09
Total	AC	3.430	2	1.715	.14
Score	BC	32.790	4	8.197	.68
	ABC	29.424	4	7.356	.61
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{106696.583}{21.480} =$	4967.252	413	12.027	
	A (Film vs. live)	2.244	1	2.244	.53
	B (Previous knowledge)	106.556	2	53.278	12.54**
	C (Attitude toward physics)	19.543	2	9.772	2.30
Special	AB	12.478	2	6.239	1.47
Exam	AC	8.334	2	4.167	.98
Question	BC	35.198	4	8.800	2.07
Score	ABC	18.036	4	4.509	1.06
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{33830.101}{20.263} =$	1669.517	393	4.248	

** = Significant at .01 level

results were obtained using AP as Factor C. Again, no significant differences between the groups were found other than that corresponding to the main effect of previous knowledge of the physics subject-matter.

Discussion and Conclusions

With respect to the various student attitudes studied, a number of conclusions appear warranted. Worthy of note also are the findings regarding previous knowledge of the subject-matter, the effects of which have been shown to exist independently of those of the attitude variables. This previous knowledge variable, while reappearing in each study throughout the entire investigation, will receive discussion only in this chapter. The overall film presentation vs. live presentation comparison, which is also tested in every analysis, will also be treated extensively only in this section.

Students' attitudes toward instructional films have been shown to be differentially related to learning from film vs. learning from conventional presentation methods within one specific segment of the student sample employed. This interaction effect, found in the analysis using attitude toward instructional films as Factor C and the immediate recall score as criterion, is demonstrated graphically in Figure 1.

When only students with little or no previous knowledge of physics were considered, a significant difference in amount learned favoring the live presentation group was observed among individuals holding relatively unfavorable attitudes toward instructional films. This difference was reversed in direction, but not significantly so, among those low previous knowledge subjects displaying relatively favorable attitudes toward instructional films. In other words, low attitude -

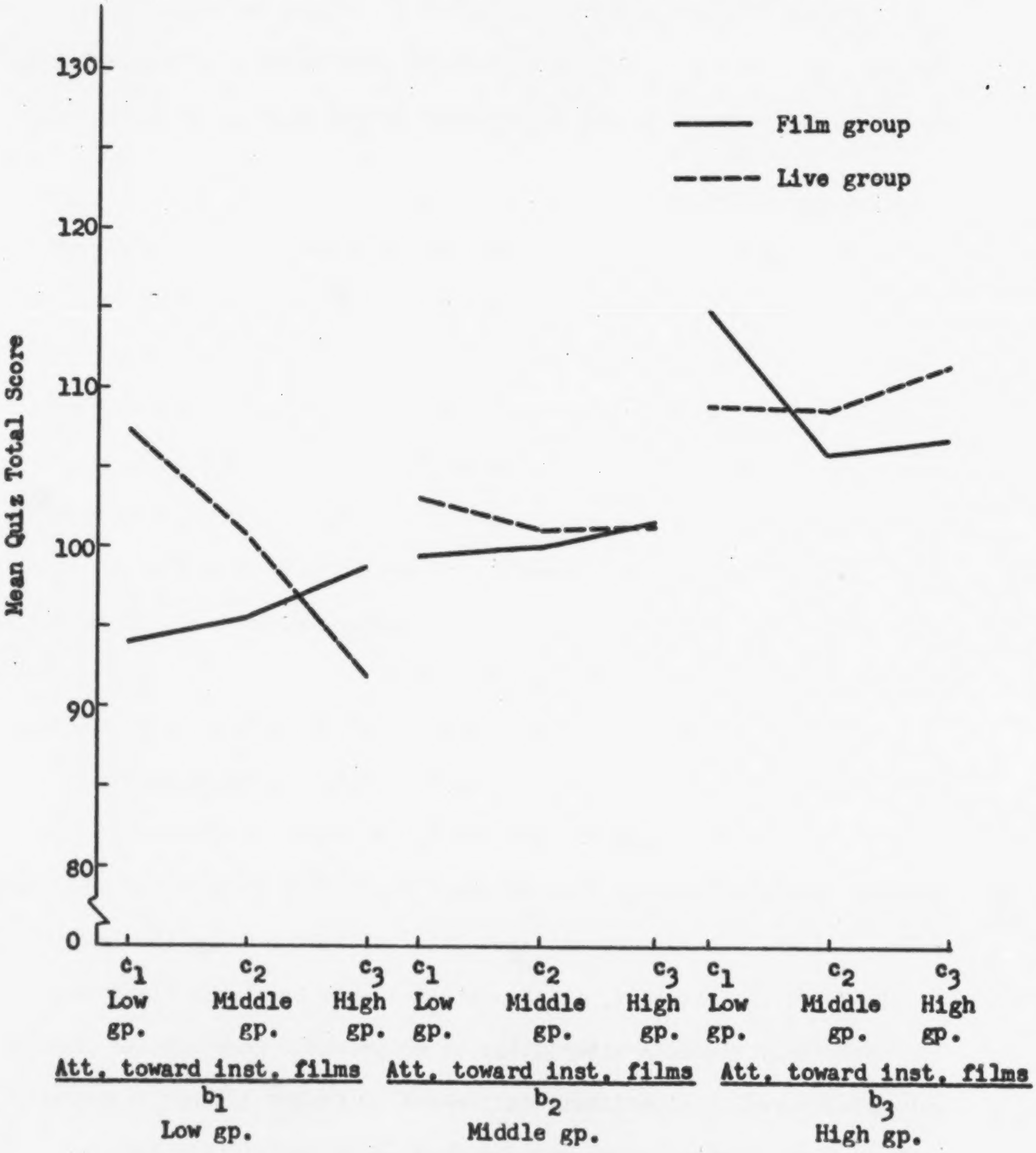

Figure 1. Graph of the ABC interaction effect for quiz total score using attitude toward instructional films as Factor C.

low previous knowledge students learned significantly more when placed in the live, conventional learning situation than when forced to learn from films. However, high attitude - low previous knowledge students tended to learn more when assigned to the film learning situation.

It might be expected that the above finding would result primarily from the poorer performance of low attitude subjects assigned to the film condition. This positive relationship between attitude toward instructional films and amount learned under the film condition is, in fact, apparent in Figure 1. More striking, however, is the negative relationship between attitude toward instructional films and amount learned which is exhibited among the live condition - low previous knowledge students. The difference in performance between film and live group, low previous knowledge subjects thus appears to be due more to an increase in learning from the high attitude - live condition to the low attitude - live condition than to a decrease in learning from the high attitude - film condition to the low attitude - film condition.

A further complication is added to the interpretation of these data when the performance of students in the high previous knowledge of physics group is considered. Here, although no differences in this group were found to be statistically significant, the profiles tend to be reversed from those observed with the low previous knowledge segment of the sample. Students with low attitudes toward instructional films seem to have learned somewhat more from film than from conventional presentation while students with more favorable attitudes appear to have learned more in the live condition than in the film condition.

One possible explanation for the observed differences in profiles may be offered here. It might be hypothesized that some other variable not included in this investigation, such as intelligence, is negatively related to attitude toward instructional films while being positively correlated with learning. Further, its correlation with learning might differ from the film presentation to the conventional presentation. Such a variable might also affect differentially the scores in different parts of the distribution of a physics achievement pretest (the measure of previous knowledge of physics). Thus, with low previous knowledge subjects, the finding that learning in a conventional setting is negatively related to attitude toward instructional films might be due to the correlations of both these variables with intelligence. The introduction of films in this group, however, might adversely affect learning among low attitude subjects causing the attitude toward instructional films - film learning relationship to tend more toward a positive value. With subjects scoring in the high previous knowledge group (such scores possibly arising from high intelligence and test-wiseness as well as extent of previous knowledge), holding relatively unfavorable attitudes toward instructional films might not impede a student's film learning. On the contrary, learning in the film setting seemed to be negatively related to attitude toward instructional films instead of positively as in the low previous knowledge group. If a negative correlation between this attitude and intelligence can still be hypothesized, then it may be that more intelligent individuals tend to learn more from film than they do in conventional learning situations within the restricted range of the high previous knowledge group.

By adding an intelligence measure to this design, either as a fourth independent variable or as a covariate, a clearer interpretation of these relationships might be possible. However, the argument for the effect of intelligence presented above is purely hypothetical. Further mention of its plausibility will be made in a later chapter. If the criterion of statistical significance is used exclusively, then all observed differences but one must be considered chance deviations from zero. It may thus be concluded that, among students who exhibited relatively unfavorable attitudes toward instructional films and who possessed little or no previous knowledge of physics, the individuals assigned to the live presentation condition performed higher, on the average, than did those assigned to the film presentation condition, using an immediate recall criterion.

The three-way interaction was present only on the immediate test criterion. It was not found using the delayed recall measure. Thus, the effect does not appear to sustain any long term difference in performance. It must be re-emphasized, however, that the delayed recall data were not obtained using the same test measure as that used for the immediate recall data. Therefore, the two criteria are not equivalent.

The analyses using attitude toward entertainment films and attitude toward physics as independent variables indicate that differences in these attitudes, considered either alone or in combination with differences in presentation conditions or previous knowledge, do not affect learning to a statistically significant extent. This inability to reject hypotheses of no difference existed for both of the criteria employed. Thus, although previous investigators have suggested that these variables are important in film learning, support for this contention cannot be justified on the basis of data collected in this situation. Some tendencies apparent in the data may be pointed out however. A slight negative relationship between attitude toward entertainment films and performance on immediate recall tests is evident in Table 31. Also, the data for the attitude toward physics - special exam question criterion shown in Table 34 seem to show higher performance associated with relatively neutral and unfavorable attitudes toward physics among high previous knowledge students vs. higher performance associated with relatively neutral and favorable attitudes toward physics among the middle previous knowledge group. While these tendencies may be suggestive of real differences, further research would be required to investigate their influence more directly. Their presence does not seem to carry implications concerning differences in film vs. live learning, which is the primary concern of this study.

Previous knowledge of the subject-matter to be taught, the material being introductory physics demonstration experiments in this case, has been found to be related positively to subsequent learning of the same and similar material. This finding holds true regardless of whether the material is presented on film or by conventional lecture methods and regardless of whether learning is measured in terms of immediate or delayed recall. This effect may be seen graphically by comparing the relative elevations of the three configurations in Figure 1. The general importance of this variable has been hypothesized and demonstrated before so its emergence here is not unexpected. Further, it does not seem to have more or less effect on film learning than it does on conventional, live learning. The finding that previous knowledge of the subject matter may affect the observed relationship between a given learner characteristic and film vs. live learning, however, is well worthy of note. It seems obvious that further research concerning personal characteristics of the learner must either include or control the variable of previous knowledge of the material learned.

No overall difference between performance under film and live learning conditions was found using either criterion measure. The slight tendency for the live group to obtain higher average scores than the film group proved not to be significant. This statistical test is directly comparable to that applied by Tendam (1961) as discussed in a previous section of this paper. A lack of agreement between the results of these two applications would be expected to arise only from slight differences in the number of subjects included or from differences in computational procedures between Tendam's analysis of covariance (with weighted sums of means) and this study's analysis of variance (using unweighted means analysis).

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CHAPTER IV

PERSONALITY FACTORS

Analyses and Results

The five personality variables for which analyses are presented in this chapter are ascendancy, responsibility, emotional stability, sociability, and total score on the Gordon Personal Profile. These variables were defined as A-GPP, R-GPP, E-GPP, S-GPP, and T-GPP, respectively.

The summary of the ANOVs using A-GPP as Factor C may be found in Table 7. Pertinent data for the cells of these analyses appear in Tables 35 and 36. Aside from the main effects of previous knowledge of physics, discussed in previous chapters, one effect was found to be significant at the .05 level. This effect, the AC term for the analysis using the quiz total score dependent variable, represents an interaction between the film vs. live presentation conditions and the levels of A-GPP. The simple effects of Factor A at each level of C were thus computed and the results of these tests appear in Table 8. The effects of A at c_3 were found to be significant at the .05 level while variation due to A at c_2 and A at c_1 did not differ significantly from that expected by chance alone. Referring these results to the AC summary included in Table 35, it may be concluded that, among subjects who obtained high ascendancy scores, those assigned to the live presentation group performed significantly higher on immediate recall tests than did those assigned to the film presentation group. No difference

Table 7

Summary of Analyses of Variance for Ascendancy

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	13.298	1	13.298	.93
	B (Previous knowledge)	605.160	2	302.580	21.24**
	C (Ascendancy)	40.817	2	20.408	1.43
	AB	1.681	2	.840	.06
	AC	103.295	2	51.648	3.62*
	BC	22.656	4	5.664	.40
	ABC	65.192	4	16.298	1.14
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{88076.243}{17.266} =$	5101.138	358	14.249	
Special Exam Question Score	A (Film vs. live)	1.055	1	1.055	.21
	B (Previous knowledge)	129.785	2	64.892	12.93**
	C (Ascendancy)	14.991	2	7.496	1.49
	AB	12.448	2	6.224	1.24
	AC	6.515	2	3.258	.65
	BC	14.650	4	3.662	.73
	ABC	3.370	4	.842	.17
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{28890.246}{16.7380} =$	1726.027	344	5.018	

* = Significant at .05 level
** = Significant at .01 level

Table 8

Tests of Simple Effects of Film vs. Live Learning (A)
at Each Level of Ascendancy (C)

Source of Variation	df	MS	F
A at c_3	1	87.747	6.16*
A at c_2	1	3.812	.27
A at c_1	1	25.035	1.76
Within cell/$\overline{n}_h$	358	14.249	

Where: c_3 = high ascendancy group
c_2 = middle " "
c_1 = low " "

* = Significant at .05 level

existed between film and live conditions among students in the middle or low ascendancy groups, however. This effect did not appear using the special exam question criterion.

The ANOVs and tables of cell data for R-GPP appear in Tables 9, 37, and 38, respectively. As in the analyses using A-GPP, the variation due to the AC interaction effect was observed to be significant at the .05 level when the immediate recall criterion was used. The corresponding effect in the analysis using the delayed recall criterion failed to reach significance. Table 10 shows the simple main effects associated with the observed significant interaction effect. While the tests of A at c_3 and at c_2 showed no significant difference, A at c_1 was found to be significant at the .05 level. The appropriate cell values in the AC summary table of Table 37 indicate that the live presentation - low responsibility group subjects obtained significantly higher learning scores than did the subjects in the film presentation - low responsibility group.

Using E-GPP, S-GPP, and T-GPP as independent variables, no significant interaction or main effects were noted for either criterion measure, with the exception of the previous knowledge main effect previously described. Analyses and cell data tables for E-GPP are shown in Tables 11, 39, and 40, those for S-GPP in Tables 12, 41, and 42, and those for T-GPP in Tables 13, 43, and 44. On the basis of these data, hypotheses suggesting the existence of relationships between these variables and the other independent and dependent variables included in the ANOVs cannot be supported.

Bartlett's test of homogeneity of variance for the R-GPP and E-GPP analyses using the quiz total score criterion resulted in the hypotheses of equal variances being rejected at the .01 level of significance (see Table 28, Appendix C). Referring to Tables 37 and 39, it appears that cell $a_1b_1c_3$ for R-GPP contains an abnormally large standard deviation and that, for E-GPP, cells $a_2b_3c_2$ and $a_2b_1c_1$ contain the largest and smallest standard deviations, respectively. Since these cells are not involved in individual comparisons in these analyses and since the $\underline{F}$ statistic is robust with respect to the homogeneity assumption, it is unlikely that this heterogeneity influenced the ANOV results appreciably. The analyses were thus not altered on the basis of these Bartlett's test outcomes.

Discussion and Conclusions

Of the five personality variables studied, two have been found to interact with the film vs. live presentation conditions in their effects on learning as measured by immediate recall tests. These variables were ascendancy and responsibility. In none of the analyses was a significant effect found with respect to learning as measured by delayed recall tests.

The relationship between ascendancy and learning under the film and live presentation conditions may be seen graphically in Figure 2. Among students who were placed in the high ascendancy group on the basis of their scores on the Gordon Personal Profile, those subjects assigned to the live condition learned significantly more than did those assigned to the film condition. For students scoring in the low ascendancy range, this effect was reversed to some extent. Although this latter difference was not significant, the film presentation - low

Table 9

Summary of Analyses of Variance for Responsibility

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	14.103	1	14.103	1.03
	B (Previous knowledge)	485.913	2	242.956	17.74**
	C (Responsibility)	64.238	2	32.119	2.35
	AB	29.181	2	14.590	1.07
	AC	83.598	2	41.799	3.05*
	BC	29.434	4	7.358	.54
	ABC	108.302	4	27.076	1.98
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{86121.088}{17.564} =$	4903.161	358	13.696	
Special Exam Question Score	A (Film vs. live)	.727	1	.727	.15
	B (Previous knowledge)	93.441	2	46.720	9.60**
	C (Responsibility)	19.509	2	9.754	2.00
	AB	17.291	2	8.646	1.78
	AC	19.440	2	9.720	2.00
	BC	29.195	4	7.299	1.50
	ABC	28.251	4	7.063	1.45
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{28088.740}{16.775} =$	1674.441	344	4.868	

* = Significant at .05 level
** = Significant at .01 level

Table 10

Tests of Simple Effects of Film vs. Live Learning (A)

at Each Level of Responsibility (C)

Source of Variation	df	MS	F
A at c_3	1	8.544	.62
A at c_2	1	.000	.00
A at c_1	1	89.157	6.51*
Within cell/$\bar{n}_h$	358	13.696	

Where: c_3 = high responsibility group
c_2 = middle " "
c_1 = low " "

* = Significant at .05 level

Table 11

Summary of Analyses of Variance for Emotional Stability

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	10.224	1	10.224	.68
	B (Previous knowledge)	592.188	2	296.094	19.83**
	C (Emotional Stability)	17.343	2	8.672	.58
	AB	3.651	2	1.826	.12
	AC	25.193	2	12.596	.84
	BC	30.177	4	7.544	.51
	ABC	17.812	4	4.453	.30
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{90450.480}{16.919} =$	5346.089	358	14.933	
Special Exam Question Score	A (Film vs. live)	2.043	1	2.043	.39
	B (Previous knowledge)	134.111	2	67.056	12.95**
	C (Emotional Stability)	.766	2	.383	.07
	AB	14.111	2	7.056	1.36
	AC	31.199	2	15.600	3.01
	BC	13.180	4	3.300	.64
	ABC	14.130	4	3.532	.68
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{28764.476}{16.142} =$	1781.965	344	5.180	

** = Significant at .01 level

Table 12

Summary of Analyses of Variance for Sociability

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	13.614	1	13.614	.96
	B (Previous knowledge)	477.935	2	238.968	16.85**
	C (Sociability)	19.293	2	9.646	.68
	AB	.503	2	.252	.02
	AC	66.965	2	33.482	2.36
	BC	20.793	4	5.198	.37
	ABC	74.895	4	18.724	1.32
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{88768.596}{17.486} =$	5076.552	358	14.180	
Special Exam Question Score	A (Film vs. live)	3.219	1	3.219	.65
	B (Previous knowledge)	116.223	2	58.112	11.65**
	C (Sociability)	6.014	2	3.007	.60
	AB	5.408	2	2.704	.54
	AC	14.622	2	7.311	1.47
	BC	12.788	4	3.197	.64
	ABC	15.557	4	3.889	.78
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{28742.486}{16.754} =$	1715.611	344	4.987	

** = Significant at .01 level

Table 13

Summary of Analysis of Variance for Total Score - Gordon Personal Profile

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	.019	1	.019	.00
	B (Previous knowledge)	613.670	2	306.835	21.69**
	C (Total Score - GPP)	26.809	2	13.404	.95
	AB	2.411	2	1.206	.09
	AC	59.255	2	29.628	2.09
	BC	36.058	4	9.014	.64
	ABC	76.785	4	19.196	1.36
	$\frac{\text{Within cell}}{\tilde{n}_h} = \frac{88108.299}{17.401} =$	5063.404	358	14.144	
Special Exam Question Score	A (Film vs. live)	.340	1	.340	.07
	B (Previous knowledge)	135.212	2	67.606	13.39**
	C (Total Score - GPP)	3.593	2	1.796	.36
	AB	7.532	2	3.766	.75
	AC	7.797	2	3.898	.77
	BC	19.283	4	4.821	.96
	ABC	6.030	4	1.508	.30
	$\frac{\text{Within cell}}{\tilde{n}_h} = \frac{28824.258}{16.593} =$	1737.144	344	5.050	

** = Significant at .01 level

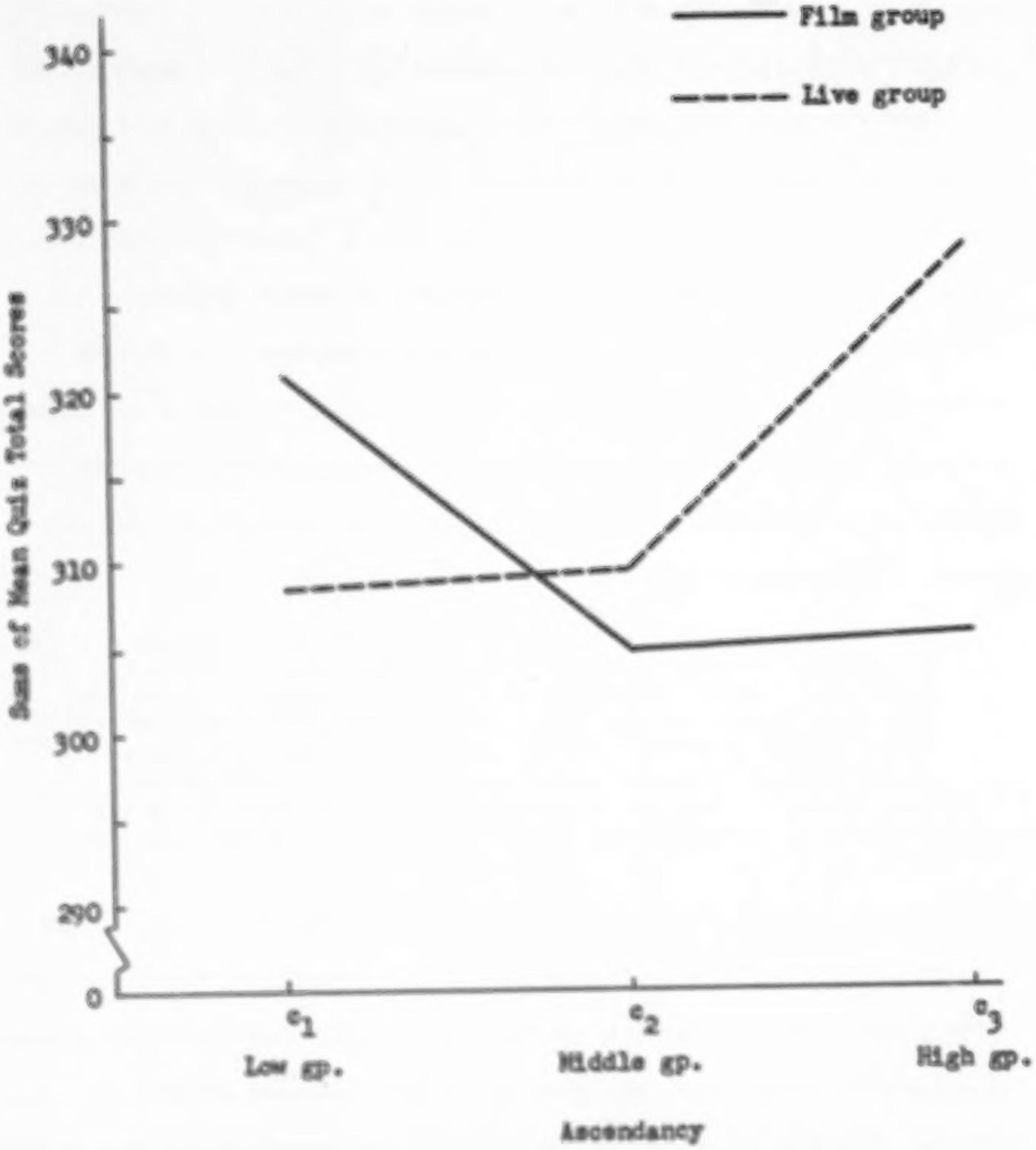

Figure 2. Graph of the AC interaction effect for the quiz total score using ascendancy as Factor C.

ascendancy subjects tended to score higher on the learning criterion than did the subjects of the live presentation - low ascendancy group.

Terms such as "ascendancy" and "responsibility", like most personality trait names, are often difficult to define except operationally. However, the Gordon Personal Profile has had the benefit of both factor analytic study and comparison with external criterion statements about the behaviors being measured. The author has attempted to provide a more general behavioral definition of each scale. To aid in the interpretation and discussion of the findings presented above, the author's definition of ascendancy has been included here, reproduced from the manual for the Gordon Personal Profile, as follows:

> "Those individuals who adopt an active role in group situations, who are self-assured and assertive in relationships with others, and who tend to make independent decisions, make high scores on this scale. Those who play a passive role in the group, who would rather observe than participate, who generally lack self-confidence, who prefer to have others take the lead, and who tend to be overly dependent on others for advice, normally make low scores on this scale." (Gordon, 1953, p. 5)

If this definition is taken literally, then the results of this study suggest that students who are characterized as "active", "self-assured", "assertive", and "independent" perform at a higher level in conventional, live learning situations than they do in film learning situations. Conversely, students described as "passive", "observers" rather than "participators", "lacking self-confidence", "followers", and "dependent on others" tend toward higher performance in film learning conditions.

Viewed in this way, these results bear interesting relation to hypotheses offered by previous investigators. Discussions by Gibson (1947) and Miller (1957) concerning an adverse effect on learning of a

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passive, spectator attitude toward instructional films are mentioned in the literature review, Appendix A. Instructional film, in its traditional usage, has in fact been considered a more passive form of learning (although recent research has shown that films can be constructed to require as much or more student participation than conventional instruction). When shown in darkened rooms without provision for active student participation, films may foster a spectator attitude which, while having a deleterious effect on the learning of active, assertive students, may be very comfortable for their more submissive peers. Also noteworthy is the Hovland, Janis, and Kelley (1953) hypothesis that high persuasibility is associated with low self-esteem while low persuasibility is associated with high self-esteem. It would seem that the more ascendant individuals should also exhibit high self-esteem. If these students are less persuasive, the observed differences in the performance of the high ascendancy students between film and live conditions may arise from the live physics demonstrations being perceived as more convincing or credible than their filmed, and therefore artificially represented, counterparts.

With respect to the responsibility variable, it has been shown that among individuals who scored in the low quarter of the responsibility scale the students assigned to the live presentation group achieved significantly higher immediate recall learning scores than did those placed in the film presentation group. As was the case with the ascendancy data, a tendency toward reversal of this effect at the other end of the responsibility continuum was noted. That is, students scoring in the high quarter of the responsibility scale learned somewhat more under the film condition than under the live condition, but not significantly so. A graph of this interaction effect is shown in Figure 3.

Responsibility, as measured by the Gordon Personal Profile, was defined as follows:

> "Those individuals who take responsibilities seriously, who are able to stick to any job and get it done, who are persevering and determined, score high on this scale. Individuals who are unable to stick to tasks that do not interest them, and in the extreme, who tend to be flighty or irresponsible, usually make low scores on this scale." (Gordon, 1953, p. 5)

Thus, subjects described as "unable to stick to tasks that do not interest them" and as "flighty or irresponsible" performed significantly higher in the conventional, live presentation condition than when presented with the film learning task. On the other hand, those who "take responsibilities seriously", who "persevere" and are "determined" appeared to learn somewhat more from film.

If less responsible individuals do not learn as well from films as they do from conventional presentations, then the conclusion that film learning, for some reason, requires a more responsible, persistent attitude on the part of the learner seems warranted. The live learning condition, in which a recognized authority in the form of a human instructor observes and questions the members of the class and in which the behavior of the class as a whole is visible to the individual student, may provide a control over the mental activity of students which is not available in the instructional film. During the film presentation, those who are unable to concentrate on material in which they are not interested need not do so. They may pursue their personal fancies even while knowing

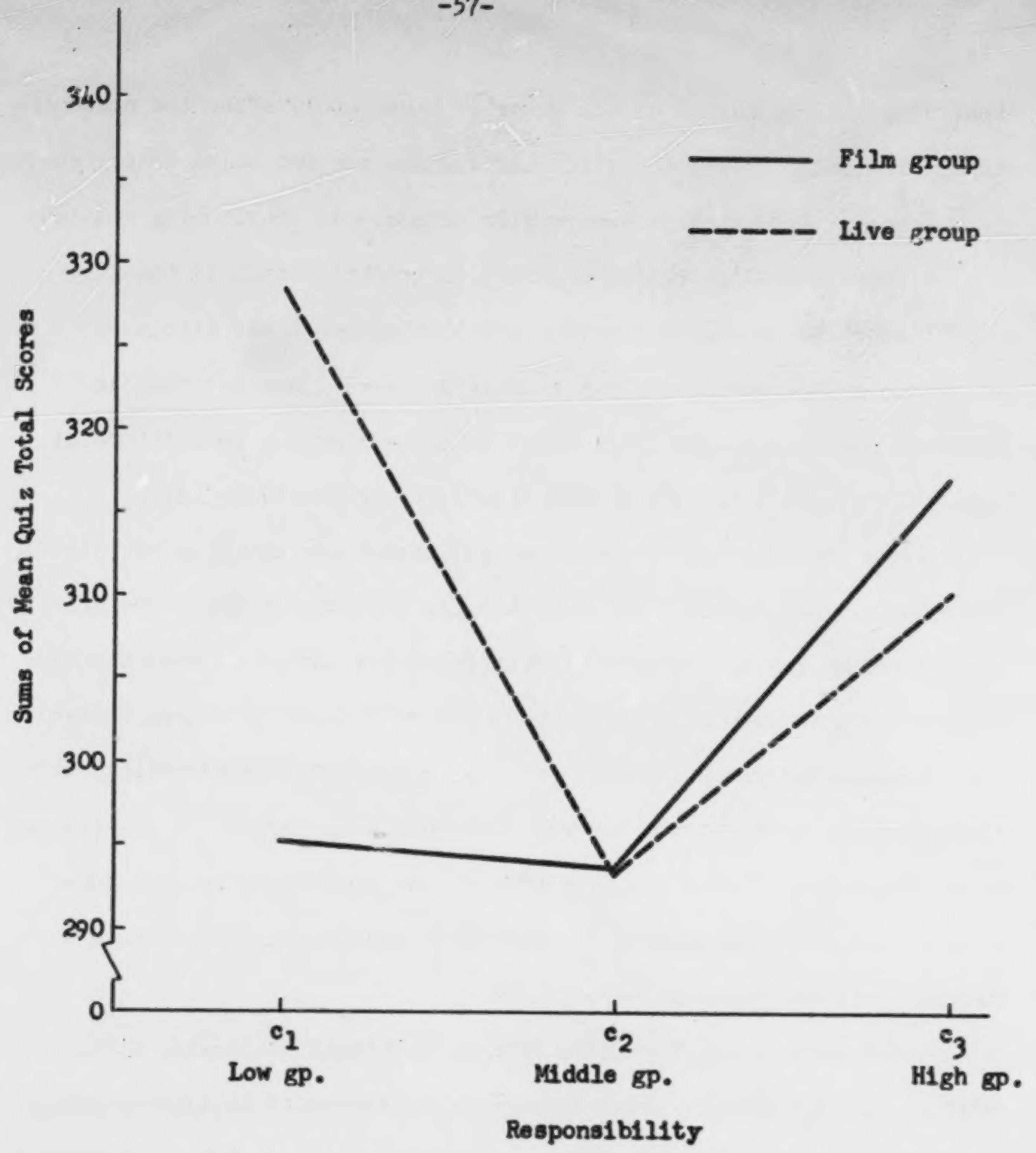

Figure 3. Graph of the AC interaction effect for quiz total score using responsibility as Factor C.

that they will be tested on the material immediately after the presentation. Possibly, more responsible individuals are motivated to persevere in a learning task without supervision or periodic questioning and thus may perform as well or better in the film condition than in the live condition. The spectator attitude hypothesis, which was discussed with respect to ascendancy, may also apply here. Less responsible students may be more likely to hold, or to succumb to, an attitude of passive, relaxed observation when viewing an instructional film.

While the interaction effect of responsibility and film vs. live learning was not found to be statistically significant using the special exam question score, the profile of this effect tended to show the same relationship as that found with the quiz total score dependent variable. This tendency suggests that the findings concerning responsibility using the immediate recall criterion may also hold with respect to the delayed recall criterion. This constant effect over time might be more concretely demonstrated using more comparable measures as immediate and delayed criteria than was possible here.

Other personality variables such as emotional stability, sociability, and the Profile total score were not shown to be significantly related to learning in either presentation condition. The conclusion follows that these personality variables as personal characteristics of learners are irrelevant to learning in this situation. Some of the differences tested, while non-significant, were relatively large. Therefore it was felt that some mention of the more important of these effects should be included in this discussion.

Emotional stability represents an anxiety or nervous tension scale which may be similar to the chronic anxiety measure used by Allison and Ash (1951) in research described in Appendix A. The findings reported by these investigators and those presented here are in general agreement concerning the lack of relationship between anxiety as a personality trait and film learning. However, using the delayed recall measure as dependent variable, the AC interaction effect approached significance at the .05 level (see Table 11). Apparently this resulted primarily from the difference between film and live learning conditions among the low emotional stability group. This difference, which favored the live presentation, may suggest that individuals who are less stable emotionally do not retain learned material as well when learning is originally mediated by film as when it is presented by conventional means. The profile of this effect parallels, to some extent, those found for the responsibility variable. Since Gordon (1953) reported some positive correlation between the responsibility and emotional stability scales, the two findings would appear to be related. Hypotheses worth further consideration might concern the interaction between responsibility and emotional stability dimensions and its differential effects on immediate learning and retention of filmically presented material.

With the sociability scale and the Profile total score, some tendencies toward AC interactions were also observed. More sociable, gregarious individuals tended to score higher on immediate recall quizzes when assigned to the live learning condition while less sociable students tended toward higher scores when assigned to the film learning condition. Individuals in the middle range of the Profile total score performed somewhat better on immediate quizzes in the live condition while subjects scoring in either the high or low range of this variable performed better under the film condition. The Profile total score supposedly indicates both respondents' actual overall self-evaluation and their tendencies to over- or underrate themselves. These data cannot support conclusions about the effects of these variables on film vs. live learning but they suggest that further study of similar relationships may not be fruitless.

CHAPTER V

INTELLECTUAL FACTORS

Analyses and Results

The three intellectual ability variables which have been related to learning under film and live presentation conditions in this chapter were obtained from mathematics and English aptitude tests and from students' previous semester grade point averages. These variables have been referred to as numerical aptitude (NA), verbal aptitude (VA), and academic achievement (AA).

Following procedures similar to those used in investigating the effects of other learner characteristics, there would be six ANOVs relating these independent variables to the criterion measures of quiz total score and special exam question score. However, as shown in Table 27 of Appendix C, the chi-square tests associated with these analyses resulted in values judged significant beyond the .01 level. The assumption that the samples of subjects constituting the cells of the BC summary tables were independent samples from the same population was therefore considered untenable. Apparently, each of the three ability variables is positively correlated with previous knowledge of physics so that the cell samples represented different population strata. The results of the Bartlett tests appearing in Table 28 of Appendix C also showed that homogeneity of variance among the cells on the quiz total score criterion could not be assumed for the analyses using NA and VA as Factor C. For these reasons, the ANOVs could not be carried out. The data were thus recast into a form which permitted comparison of film group and live group means independently within each of the population strata represented by combinations of the levels of previous knowledge of physics and the intellectual variables. The t statistic was employed for these comparisons.

The results of these t tests using NA as Factor C are shown in Table 14. For the quiz total score criterion, one difference between film group and live group means was found to be significantly greater than zero at the .01 level. This difference in immediate recall test performance favored the conventional, live presentation condition and was observed at level b_1c_3. That is, among individuals without previous knowledge of physics but with high numerical aptitude scores, those placed in the live presentation group performed higher on immediate recall tests than did those placed in the film group. No other differences were noted using the quiz total score criterion. On the delayed recall criterion, t for the film vs. live group comparison at level b_1c_3 did not attain significance. However, among the subjects of the b_2c_3 cell sample, live group students were found to score significantly higher (at the .05 level) than film group students. In other words, average performance of individuals with some previous knowledge of physics and with high numerical aptitude was higher on delayed recall tests for those assigned to the live conditions than for those assigned to the film condition.

A similar treatment of the data using VA as Factor C appears in Table 15. Using the quiz total score criterion, only one difference

Table 14

Summary of t Tests Between Film and Live Group Means

for Numerical Aptitude

Dependent Variable	Level of BC	Film Group Mean	Live Group Mean	Degrees of Freedom	t
Quiz Total Score	b_3c_3	111.19	116.15	51	- .99
	b_3c_2	110.94	108.74	70	.56
	b_3c_1	104.77	95.14	18	1.39
	b_2c_3	101.45	106.43	23	- .77
	b_2c_2	102.63	101.12	65	.49
	b_2c_1	93.46	95.40	37	- .38
	b_1c_3	100.71	116.45	30	-3.94**
	b_1c_2	98.59	97.89	70	.22
	b_1c_1	91.31	89.92	37	.21
Special Exam Question Score	b_3c_3	44.54	43.46	50	.39
	b_3c_2	40.90	40.49	66	.19
	b_3c_1	41.73	33.00	16	1.90
	b_2c_3	35.82	44.64	23	-2.42*
	b_2c_2	39.06	38.83	60	.09
	b_2c_1	34.10	35.54	32	- .55
	b_1c_3	38.14	41.55	30	- .93
	b_1c_2	33.88	35.77	68	- .84
	b_1c_1	33.79	34.00	35	- .07

Where: b_3 = high previous knowledge of physics group
b_2 = middle " " " " "
b_1 = low " " " " "
c_3 = high numerical aptitude group
c_2 = middle " " "
c_1 = low " " "

* = Significant at .05 level
** = Significant at .01 level

Table 15

Summary of t Tests Between Film and Live Group Means

for Verbal Aptitude

Dependent Variable	Level of BC	Film Group Mean	Live Group Mean	Degrees of Freedom	t
Quiz Total Score	b_3c_3	114.15	113.50	47	.11
	b_3c_2	107.97	109.00	81	- .31
	b_3c_1	104.62	106.40	11	- .14
	b_2c_3	99.33	109.67	28	-2.28*
	b_2c_2	100.00	98.59	60	.39
	b_2c_1	98.05	97.22	36	.16
	b_1c_3	107.67	105.75	23	.31
	b_1c_2	97.66	101.50	66	-1.24
	b_1c_1	92.08	92.09	47	.00
Special Exam Question Score	b_3c_3	43.60	44.62	44	- .35
	b_3c_2	41.00	39.38	78	.81
	b_3c_1	45.00	37.50	10	1.04
	b_2c_3	37.93	41.50	27	-1.02
	b_2c_2	37.61	41.29	55	-1.47
	b_2c_1	34.65	35.41	32	- .25
	b_1c_3	39.00	37.94	23	.25
	b_1c_2	34.86	37.97	64	-1.46
	b_1c_1	34.24	33.05	45	.44

Where: b_3 = high previous knowledge of physics group
b_2 = middle " " " " "
b_1 = low " " " " "
c_3 = high verbal aptitude group
c_2 = middle " " "
c_1 = low " " "

* = Significant at .05 level

between film and live groups reached significance at the .05 level. This difference occurred among individuals who had displayed some previous knowledge of physics and who had placed in the high verbal aptitude group (level b_2c_3) and favored those assigned to the live presentation treatment. The corresponding test using the delayed recall criterion did not yield similar results. With this criterion, film vs. live comparisons at other combinations of BC levels failed to uncover other statistically significant differences.

When AA was used as the third independent variable, no significant differences were observed on either criterion measure (see Table 16). Achievement in previous college course work thus did not appear to be differentially related to film vs. conventional learning conditions.

Complete cell data and summary tables for the analyses using NA, VA, and AA as independent variables are presented in Tables 45 through 50. Although no statistical treatment was applied to the data in these tables, it may be worth noting that, in all cases, a relatively large positive relationship seemed to exist between previous knowledge of physics and the learning criteria and also between the intellectual ability measures and performance on the criterion measures. These trends would correspond to the overall main effects of Factors B and C.

Discussion and Conclusions

The results of the analyses presented in this chapter indicate that real differences in amount learned existed between film and conventional presentation conditions among some of the groups of subjects studied. Those differences found significant all favored the live presentation condition. Although the groups in which these findings

Table 16

Summary of t Tests Between Film and Live Group Means for Academic Achievement

Dependent Variable	Level of BC	Film Group Means	Live Group Mean	Degrees of Freedom	t
Quiz Total Score	b_3c_3	119.92	118.93	51	.24
	b_3c_2	107.46	108.38	71	- .24
	b_3c_1	93.80	100.00	22	-1.04
	b_2c_3	104.73	111.12	25	-1.16
	b_2c_2	100.36	100.62	66	- .08
	b_2c_1	95.05	93.62	33	.29
	b_1c_3	109.44	113.00	18	- .68
	b_1c_2	100.45	99.91	83	.18
	b_1c_1	89.17	85.07	42	.74
Special Exam Question Score	b_3c_3	46.42	46.37	51	.03
	b_3c_2	40.89	39.10	66	.81
	b_3c_1	36.38	33.43	20	.67
	b_2c_3	42.36	42.81	25	- .11
	b_2c_2	36.81	40.68	63	-1.87
	b_2c_1	33.69	33.00	27	.22
	b_1c_3	38.11	44.45	18	-1.57
	b_1c_2	35.64	36.00	81	- .19
	b_1c_1	32.93	29.54	40	1.08

Where: b_3 = high previous knowledge of physics group
b_2 = middle " " " " "
b_1 = low " " " " "
c_3 = high academic achievement group
c_2 = middle " " "
c_1 = low " " "

arose differed on the basis of previous knowledge of physics, all were high ability groups. There was some tendency for relatively large, though non-significant, mean differences to appear in other ability levels in some of the analyses.

Individuals with high numerical aptitude but with no previous knowledge of physics performed significantly higher on immediate recall tests when the material was presented to them using conventional lecture demonstration methods. There was also a tendency for low numerical aptitude subjects who had had substantial previous knowledge of physics to achieve higher immediate learning scores in the film-mediated condition. These data are shown graphically in Figure 4 while those for the delayed learning criterion appear in Figure 5. Here, the same tendency for low numerical aptitude - high previous knowledge subjects to learn more when in the film group existed. The significant difference between film vs. live conditions among high numerical aptitude - low previous knowledge students was not repeated with this criterion, however. Delayed learning scores did differ significantly among the high numerical aptitude - middle previous knowledge group. This difference again favored the live presentation conditions.

These results justify the conclusion that the conventional method of presentation is superior to the film medium for students with high numerical ability and average or below average previous knowledge of the subject matter. Although the converse of this conclusion cannot be substantiated statistically, it may be that the film presentation is superior for less able students who do however command an above average knowledge of the subject matter before it is presented.

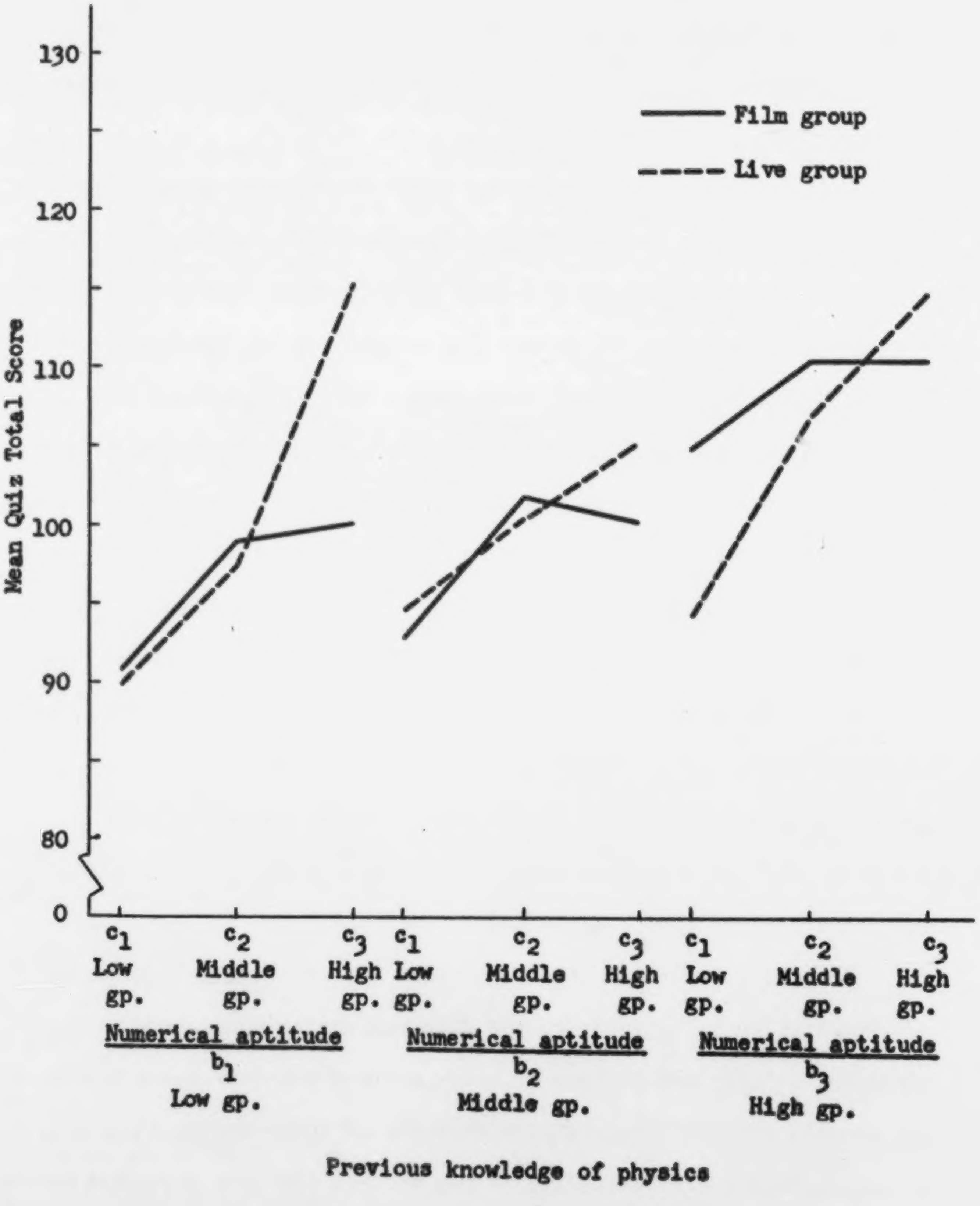

Figure 4. Graph of individual cell means for quiz total score using numerical aptitude as Factor C.

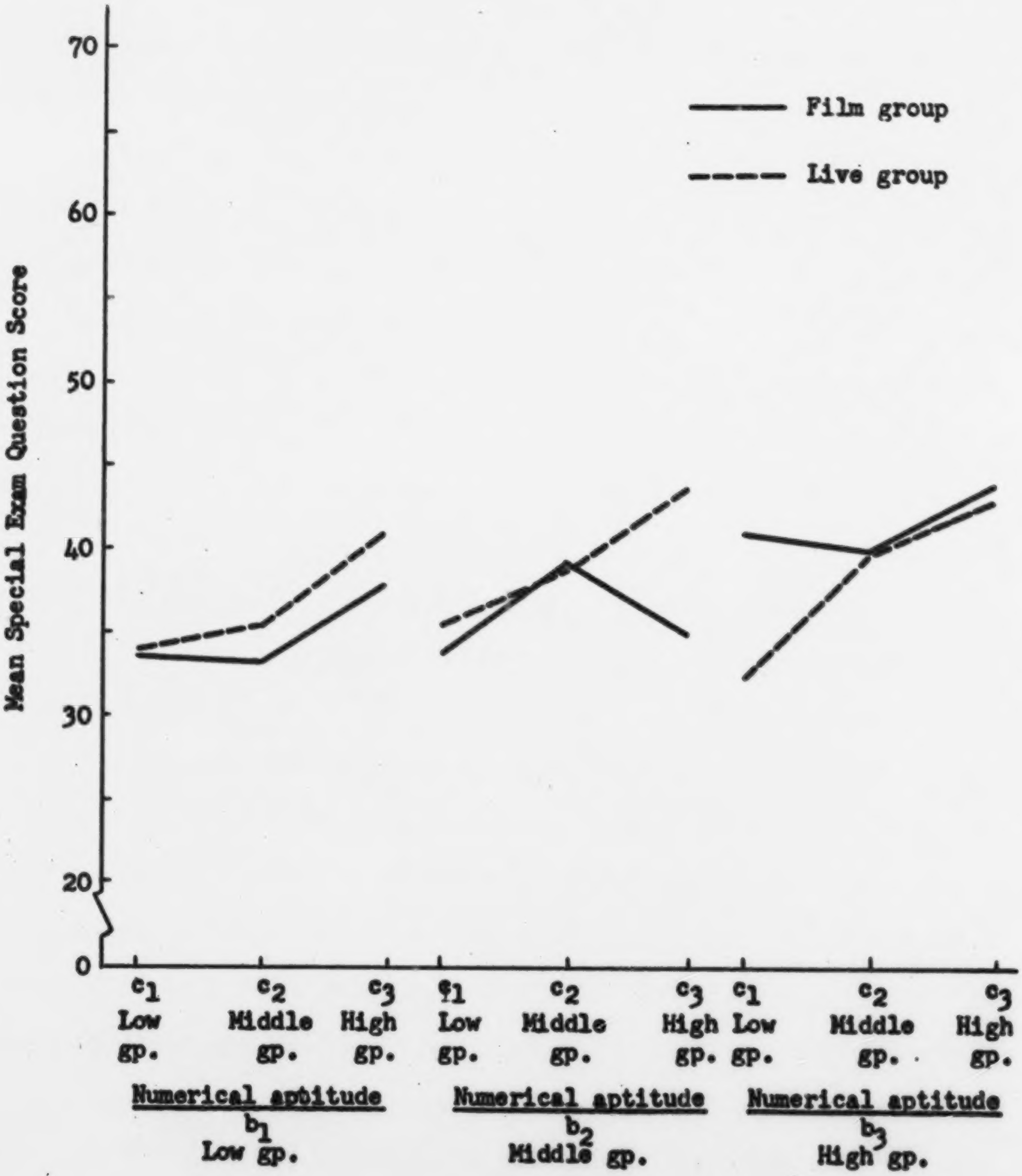

Figure 5. Graph of individual cell means for special exam question score using numerical aptitude as Factor C.

Among the possible explanations of these findings which may be offered, one might emphasize the consistent, although not always significant, superiority of the live condition among high numerical ability subjects illustrated in Figure 4. The trends for the film learning condition regularly level off between the middle and high ability groups while continuing to increase for the conventional learning condition. The live situation may permit the exercise of higher-order numerical abilities in such a way that learning continues to be facilitated above a certain minimum prerequisite ability level. Film, on the other hand, may not provide such conditions so that, above a certain point, numerical ability is no longer related to further increases in learning. In addition, the superiority of film for low ability - high previous knowledge subjects could result from increased clarity in presenting physics experiments through film. Filmic presentation of physical measurements and the complex formulae involved in them may provide visualization of the mathematics of the physics experiment which the live presentation cannot match. While low ability students may be unable to provide this visualization for themselves, those with sufficient previous knowledge of physics may profit from the film demonstration where less experienced students may not. It is conceivable that this same structured simplicity of the film presentation might inhibit the performance of high ability film subjects, especially those with an insufficient background of knowledge in physics. On the delayed criterion measure, some of these differences diminish. However, these findings need not be viewed as inconsistent with the interpretations offered above.

With respect to the verbal aptitude variable, the conventional presentation would appear to be the more appropriate method for students with high verbal aptitude and some previous knowledge of physics when learning is measured by immediate recall. As shown in Figure 6, verbal aptitude and learning are positively correlated in both film and live treatment conditions for the high and the low previous knowledge groups. In the middle previous knowledge group however, this relationship does not exist for the film condition subjects. Possibly, among these students, performance in the live condition is more dependent upon verbal ability than in the film condition. Similar effects were not found using the delayed criterion. In general, when students exhibit high proficiency on both previous knowledge and on verbal or numerical aptitude measures or when they score in the low ranges on both measures, the data do not indicate that either presentation method is more appropriate. Differences seem to arise predominantly among students whose scores on the previous knowledge measure and the aptitude measures are disparate.

It is not unreasonable to assume that the aptitude measures used in these analyses represent, or are correlated to some extent with, various aspects of intelligence. Therefore, some findings and hypotheses noted elsewhere in this report deserve discussion here.

Research by Radlow (1955) demonstrated that several dimensions of mental ability were correlated with gain in learning from film and that verbal comprehension (vocabulary definition) and general reasoning (arithmetic problem-solving) should be included in a test battery designed to select superior film learners. In the present study, numerical aptitude (arithmetic and algebraic problem-solving) and verbal aptitude (spelling and vocabulary definition) have been shown to be

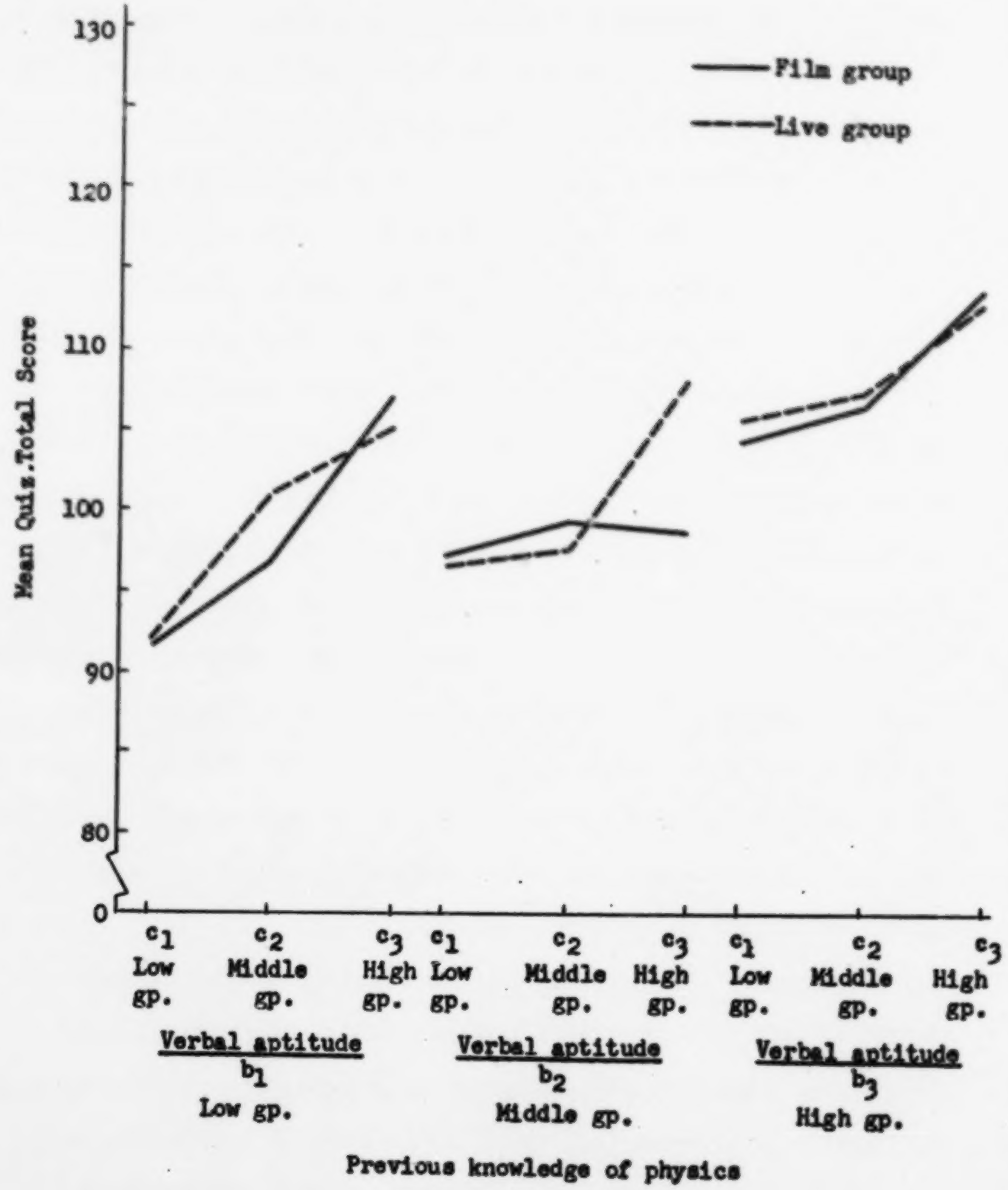

Figure 6. Graph of individual cell means for quiz total score using verbal aptitude as Factor C.

related to amount learned in both film and conventional learning situations. Here, however, some differences in these relationships between film and live conditions have been uncovered. The graphs of Figures 4, 5, and 6 indicate that numerical and verbal aptitude scores are not related to film learning to the same extent as they are to conventional learning among some groups of subjects. Comparison of Radlow's results and those of this research is admittedly difficult due to differences in the films and the variables, both independent and dependent, used in the two studies. However, it would appear that the relationships between these mental abilities and film learning are much more complex than has previously been demonstrated. A predictor battery composed of these variables might select superior learners in general but it would not indicate which students will learn from films more proficiently than from conventional presentations. Apparently, in some of the previous knowledge groups studied here, additional numerical or verbal ability beyond a certain point does not result in continued increases in learning from films as it appears to do in learning with conventional methods. There is also some indication that the use of film in place of live methods may result in increased learning among individuals with low numerical aptitudes but who possess substantial previous knowledge of the subject matter. A distinction between two types of superior film learners may profitably be made. Some individuals may learn more from films or from any other medium than other individuals because they possess certain mental abilities which the others do not. Also, some individuals may learn more from films than they themselves (or individuals similar to them in other respects) learn from any other medium because they possess certain abilities which are uniquely appropriate to film learning. Depending on the purposes to be served, the selection of "superior film learners" would appear to require the isolation of either one or both of these types of individuals.

In Chapter III, an hypothesis was advanced in partial explanation of findings concerning attitude toward instructional films. It was suggested that intelligence might be negatively correlated with this attitude while being positively correlated with learning. If numerical and verbal aptitude can be considered aspects of intelligence, then the hypothesis does not gain additional support from analyses presented in this chapter. The aptitude variables have been found to be positively correlated with the learning criteria and, to some extent, differentially so for film vs. live conditions. However, if the hypothesis is assumed to be true, then, in the low previous knowledge group, the significant difference favoring high NA students in the conventional condition (Figure 4) would correspond to the significant difference favoring low AIF students in the conventional condition (Figure 1, Chapter III). It would be expected that many of the subjects involved in one of these comparisons would also be involved in the other. However, a frequency count in the pertinent cells indicated that, out of 68 subjects involved in the two comparisons, only 5 film group subjects and 4 live group subjects were involved in both comparisons. The criterion scores of these two groups of students did not appear to differ. Further, the profiles for the high previous knowledge groups in Figures 1 and 4 do not compare in a manner which would be predicted from the assumed hypothesis. Likewise, the findings concerning verbal aptitude do not correspond meaningfully to those reported in Chapter III. Thus, although the hypothesis in question has not been tested statistically, its plausibility is questioned by the findings reported for the intellectual variables in this chapter.

Academic achievement was not found to be associated with film vs. live group differences at any of the levels of previous knowledge. A marked positive relationship between this variable and learning appears to exist in both presentation groups. It can thus be concluded that performance in previous college work is highly correlated with amount learned in subsequent college courses but that differences in this correlation between film learning and conventional learning remain to be demonstrated. This finding is not unexpected.

The possibilities suggested in the interpretations presented in this chapter require further testing. Although those differences which have been discussed appear real, the discussions concerning their origins and implications have gone beyond the bounds of this study. This has been done in the hope of generating hypotheses in this relatively unexplored area which are worth further examination.

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CHAPTER VI

PAST EXPERIENCE FACTORS

Analyses and Results

Three past experience variables were studied. These were defined as past experience with instructional films (PXIF), past use of the Purdue Film Library (PUFL), and past experience with entertainment films (PXEF). PXIF and PUFL may both be considered indexes of experience with instructional films. The former represents the extent to which a student has been exposed to instructional films in formal high school and college courses before beginning the experiment. The latter represents less formal past experience gathered both before and during the experiment. The Purdue Film Library contains, predominantly, instructional films which students come in to view voluntarily or which are assigned as regular course content by some instructors.

In addition to the two dependent variables used in the analyses presented in previous chapters, three other criteria were applied to evaluate the importance of past experience factors. These consisted of subtotals of quiz scores which were computed separately for the first five quizzes, the second five quizzes, and the third four quizzes. They are referred to in the text as quiz subtotal score (1-5), quiz subtotal score (6-10), and quiz subtotal score (11-14), respectively. By breaking the series of films down into subgroups in this manner, it was hoped that additional information concerning within-experiment practice effects might be obtained.

Table 17 presents the results of the ANOVs carried out using PXIF as Factor C. As may be seen from an inspection of this table, no significant differences were indicated between any of the treatment conditions on either the quiz total score or the special exam question score, except for the main effect of previous knowledge of physics which has been dealt with previously. When the quiz total score was broken down into first, second, and third stages of practice within the course, however, one additional finding emerged. Besides the main effect of previous knowledge, the overall main effect of film vs. live presentation was significant at the .05 level for quiz subtotal score (11-14). The tables of cell data corresponding to these five ANOVs are Tables 51, 52, 53, 54, and 55. Referring to Table 55, the significant main effect is seen to have arisen from the higher average performance exhibited by the live group subjects over that of the film group subjects. This result suggests that, while no overall differences existed between the film and conventional presentations when all 14 quizzes were taken together, films associated with quizzes #11 to #14 were not as effective instructionally as were their live instruction counterparts.

For the PUFL independent variables, five analyses similar to those carried out using the other past experience variables had been planned. However, after the data had been collected, it was recognized that two changes in the planned analyses were required. First, it was found that a majority of the subjects reported that they had not used the Purdue Film Library at all. Since dividing the remaining subjects into an additional two levels would have made the frequencies in some cells too

Table 17

Summary of Analyses of Variance for Past Experience with Instructional Films

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Total Score	A (Film vs. live)	7.528	1	7.528	.59
	B (Previous knowledge)	605.446	2	302.723	23.69**
	C (Past experience with instructional films)	38.921	2	19.460	1.52
	AB	2.233	2	1.116	.09
	AC	11.993	2	5.996	.47
	BC	72.911	4	18.228	1.43
	ABC	71.650	4	17.912	1.40
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{105259.340}{19.993} =$	5264.810	412	12.779	
Special Exam Question Score	A (Film vs. live)	3.770	1	3.770	.81
	B (Previous knowledge)	133.629	2	66.814	14.31**
	C (Past experience with instructional films)	.420	2	.210	.04
	AB	5.014	2	2.507	.54
	AC	1.634	2	.817	.17
	BC	40.030	4	10.008	2.14
	ABC	16.720	4	4.180	.90
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{34222.837}{18.746} =$	1825.607	391	4.669	
Quiz Subtotal Score (1-5)	A (Film vs. live)	57.433	1	57.433	.21
	B (Previous knowledge)	6591.038	2	3295.519	12.20**
	C (Past experience with instructional films)	567.320	2	283.660	1.05
	AB	102.799	2	51.400	.19
	AC	1613.086	2	806.543	2.98
	BC	1571.239	4	392.810	1.45
	ABC	773.739	4	193.435	.72
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{1003879.500}{13.174} =$	76201.571	282	270.218	

Table 17 (Cont.)

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Subtotal Score (6-10)	A (Film vs. live)	154.076	1	154.076	.72
	B (Previous knowledge)	2748.952	2	1374.476	6.42**
	C (Past experience with instructional films)	96.303	2	48.151	.22
	AB	10.981	2	5.490	.03
	AC	433.123	2	216.562	1.01
	BC	901.591	4	225.398	1.05
	ABC	911.391	4	227.848	1.06
	$\frac{\text{Within cell}}{\bar{n}_h}$ $\frac{795432.100}{13.174}$	60378.936	282	214.110	
Quiz Subtotal Score (11-14)	A (Film vs. live)	669.474	1	669.474	3.88*
	B (Previous knowledge)	3225.298	2	1612.649	9.35**
	C (Past experience with instructional films)	374.690	2	187.345	1.09
	AB	322.664	2	161.332	.94
	AC	250.884	2	125.442	.73
	BC	880.476	4	220.119	1.28
	ABC	55.927	4	13.982	.08
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{640496.320}{13.174} =$	48618.212	282	172.405	

* = Significant at .05 level
** = Significant at .01 level

small, only two levels of PUFL were established. These levels could be denoted as "users" (level c_2) and "non-users" (level c_1) of the Film Library. Second, although the usual chi-square test on the frequencies in the BC summary table did not attain significance (see Table 27, Appendix C), some relationship among the frequencies existing in the cells of the AC summary table was noticed. In other words, the film and live groups seemed to differ consistently in terms of the number of students who reported using the Purdue Film Library. Chi-square tests on the AC tables for all criterion measures resulted in values ranging from 6.51 to 9.52 (df = 1), each of which either exceeded or closely approached the .01 level of significance. Thus, it was found that more live group students had used the Film Library than film group students. Among the users of the Film Library, extent of use (number of reported visits) did not appear to differ among film and live group subjects. Since the original assignment of students to the two learning conditions had been randomly determined, it might be assumed that this difference occurred as a result of the difference in experimental conditions applied. Possibly, live group students, when they recognized that another section of the course was receiving filmed demonstrations, tried to compensate by visiting the Film Library to view these or other physics films. The series of experimental films was not made available in the Film Library until after the completion of the experiment. Other library films might have been viewed but their relation to the material presented in the course would be negligible. Because of these real differences in cell frequencies, it was felt that unweighted means analysis would not be appropriate. The data were treated, instead, in a manner similar to that used with the intellectual variables of Chapter V. The cell frequencies were taken into account through the application of the t statistic to test differences between the film and live group means at each of the combined levels of previous knowledge and PUFL.

In Table 18, the results of the t tests are shown for the five dependent variables. Using quiz total score, the immediate recall criterion, no differences between performance under film and live conditions were apparent. When the special exam question criterion was considered, it was found that the members of the film group scored significantly higher (at the .05 level) than those of the live group among individuals who were characterized as users of the Film Library with little previous knowledge of physics. Thus, in terms of delayed recall, students having some experience with instructional films in the Purdue Film Library but little knowledge of physics seemed to profit more from the film presentations than from the conventional presentations.

No differences were found using quiz subtotal score (1-5). In later stages of the course however, two statistically significant differences and two other seemingly important differences emerged. The film presentations were shown to be superior among users of the Film Library with little previous knowledge during the second of the three segments of the course while, using quiz subtotal score (11-14), the live presentations proved superior for individuals who had not used the Film Library and who possessed little knowledge of physics beforehand. Further, relatively large but non-significant differences were observed among Film Library users with high previous knowledge on both quiz

Table 18

Summary of *t* Tests Between Film and Live Group Means for Past Use of Purdue Film Library

Dependent Variable	Level of BC	Film Group Mean	Live Group Mean	Degrees of Freedom	*t*
Quiz Total Score	b_3c_2	110.78	110.06	25	.12
	b_3c_1	110.31	113.02	110	- .80
	b_2c_2	105.88	103.14	20	.43
	b_2c_1	98.94	101.18	91	- .75
	b_1c_2	100.60	95.24	25	1.02
	b_1c_1	98.00	99.73	107	- .55
Special Exam Question Score	b_3c_2	42.75	40.11	24	.55
	b_3c_1	41.87	41.89	105	- .02
	b_2c_2	43.88	36.23	19	1.72
	b_2c_1	36.12	39.76	86	-1.89
	b_1c_2	39.20	33.18	25	2.25*
	b_1c_1	35.05	36.42	105	- .78
Quiz Subtotal Score (1-5)	b_3c_2	318.80	321.00	17	- .08
	b_3c_1	332.90	334.06	82	- .08
	b_2c_2	284.71	300.90	15	- .63
	b_2c_1	286.34	299.41	65	- .86
	b_1c_2	301.50	290.29	11	.28
	b_1c_1	283.90	297.60	80	-1.10

Table 18 (Cont.)

Dependent Variable	Level of BC	Film Group Mean	Live Group Mean	Degrees of Freedom	*t*
Quiz Subtotal Score (6-10)	b_3c_2	323.80	279.79	17	1.81
	b_3c_1	291.96	295.53	82	- .26
	b_2c_2	279.86	268.00	15	.52
	b_2c_1	270.57	262.44	65	.65
	b_1c_2	286.67	231.29	11	2.57*
	b_1c_1	262.77	270.60	80	- .70
Quiz Subtotal Score (11-14)	b_3c_2	324.40	276.64	17	2.02
	b_3c_1	284.00	299.81	82	-1.54
	b_2c_2	294.71	277.00	15	.75
	b_2c_1	253.57	263.34	65	- .98
	b_1c_2	273.17	260.29	11	.45
	b_1c_1	244.90	278.20	80	-2.93**

Where: b_3 = high previous knowledge of physics group
b_2 = middle " " " " "
b_1 = low " " " " "
c_2 = use of Purdue Film Library
c_1 = no use of " " "

* = Significant at .05 level
** = Significant at .01 level

subtotal score (6-10) and quiz subtotal score (11-14). These differences both favored the film presentation conditions. Complete cell data for all of these comparisons are located in Tables 56, 57, 58, 59, and 60.

The PXEF variable was treated by unweighted means analysis, as planned. Although the judgments on which both PXEF and PUFL were based had been collected at the same time using similar types of questions, no relevant differences in cell frequencies were noted for PXEF. The ANOVs using this variable as Factor C appear in Table 19. No significant effects were found for the criterion measures arising from data covering the entire semester. One effect deserves attention, however, in the quiz subtotal score analyses. Using quiz subtotal score (6-10), the AC interaction effect was observed to be significant beyond the .05 level. The simple main effects associated with this interaction are demonstrated in Table 20. The variation due to A at c_3, which represents the effects of film vs. live instruction among frequent moviegoers, was significant at the .01 level. Among individuals whose attendance at entertainment films and movies may be classified as average or infrequent, no film vs. live comparisons yielded statistically significant results. Cell data for all of the analyses may be inspected in Tables 61, 62, 63, 64, and 65. Table 64 shows that the significant simple main effect favors those frequent moviegoers who were assigned to the film presentation group. This effect was not found using the quiz subtotal score (1-5) or the quiz subtotal score (11-14) criteria.

Discussion and Conclusions

The importance of the role played by past experience in determining

Table 19

Summary of Analyses of Variance for Past Experience with Entertainment Films

Dependent Variable	Source of Variation	SS	df	MS	F
	A (Film vs. live)	1.843	1	1.843	.14
	B (Previous knowledge)	493.579	2	246.790	18.51**
	C (Past experience with entertainment films)	35.062	2	17.531	1.32
Quiz	AB	1.549	2	.774	.06
Total	AC	14.030	2	7.015	.53
Score	BC	29.065	4	7.266	.55
	ABC	92.431	4	23.108	1.73
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{92051.682}{18.612} =$	4945.824	371	13.331	
	A (Film vs. live)	.001	1	.001	.00
	B (Previous knowledge)	111.124	2	55.562	12.37**
	C (Past experience with entertainment films)	8.634	2	4.317	.96
Special	AB	3.129	2	1.564	.35
Exam	AC	25.614	2	12.807	2.85
Question	BC	6.458	4	1.614	.36
Score	ABC	35.941	4	8.985	2.00
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{29080.116}{18.136} =$	1603.447	357	4.491	
	A (Film vs. live)	20.626	1	20.626	.08
	B (Previous knowledge)	4662.911	2	2331.456	8.75**
	C (Past experience with entertainment films)	90.515	2	45.258	.17
Quiz	AB	305.240	2	152.620	.57
Subtotal	AC	767.201	2	383.600	1.44
Score	BC	1529.352	4	382.338	1.44
(1-5)	ABC	1073.133	4	268.283	1.01
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{919121.124}{13.069} =$	70328.344	264	266.395	

Table 19 (Cont.)

Dependent Variable	Source of Variation	SS	df	MS	F
Quiz Subtotal Score (6-10)	A (Film vs. live)	660.645	1	660.645	3.09
	B (Previous knowledge)	2814.193	2	1407.096	6.58**
	C (Past experience with entertainment films)	465.006	2	232.503	1.09
	AB	5.032	2	2.516	.01
	AC	1730.661	2	865.330	4.04*
	BC	672.740	4	168.185	.79
	ABC	585.837	4	146.459	.68
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{738142.702}{13.069} =$	56480.427	264	213.941	
Quiz Subtotal Score (11-14)	A (Film vs. live)	529.798	1	529.798	3.17
	B (Previous knowledge)	3043.512	2	1521.756	9.10**
	C (Past experience with entertainment films)	50.146	2	25.073	.15
	AB	877.223	2	438.612	2.62
	AC	257.483	2	128.742	.77
	BC	268.310	4	67.078	.40
	ABC	1571.048	4	392.762	2.35
	$\frac{\text{Within cell}}{\bar{n}_h} = \frac{577148.756}{13.069} =$	44161.662	264	167.279	

* = Significant at .05 level
** = Significant at .01 level

Table 20

Tests of Simple Effects of Film vs. Live Learning (A) at Each Level of Past Experience with Entertainment Films (C) Using Quiz Subtotal Score (6-10)

Source of Variation	df	MS	F
A at c_3	1	1442.065	6.74**
A at c_2	1	333.663	1.56
A at c_1	1	615.578	2.88
Within cell/$\bar{n}_h$	264	213.941	

Where: c_3 = high past experience with entertainment films group
c_2 = middle " " " " " "
c_1 = low " " " " " "

** = Significant at .01 level

the behavior of individuals in new situations has long been a basic issue in psychology. That the experience variable deserves careful study in learning research has been lucidly argued by both Harlow (1949) and Bateson and Ruesch (1951) as discussed in Appendix A. Harlow (1949) has especially criticized what he referred to as "blitzkrieg" research. While the present investigation does not purport to include a very large longitudinal sample of students' performances, it is believed that reasonable indices of students' past experience before beginning the experiment were used and that sufficient opportunity for practice effects to operate within the experiment was provided. Some of the results presented in this chapter bear interesting relation to findings and hypotheses advanced by previous investigators concerning the importance of these variables to film learning in particular. Also, additional hypotheses may be tendered for further examination on the basis of these results.

The past experience with instructional films (PXIF) variable was not found to be related to learning under film and/or conventional conditions regardless of the criterion measure employed. As implied in Chapter II, this variable may have suffered from the use of a less precise method of measurement than was possible for the other past experience factors studied. Whether this deficiency affected the obtained results cannot be determined. It must be concluded that this research offers no indication that past experience with instructional films, as measured by PXIF, is an important factor in learning either from films or from conventional instruction.

When the immediate recall measure was divided into its subtotal scores for the analyses using past experience with instructional films (PXIF) at each stage of practice through the course, one finding worth mention was uncovered. The subset of films associated with the third stage of practice (quizzes #11 through #14) appeared to be inferior in terms of instructional effectiveness to the corresponding subset of live presentations. That is, while no overall differences between film and live presentation conditions have been found using student performance over the entire course, students scored higher on quizzes associated with the last four physics demonstrations when these presentations were made using conventional methods rather than film. The conclusion follows that real differences favoring conventional instruction exist between film vs. live presentation of the last four demonstrations regardless of previous knowledge of physics or past experience with instructional films.

A number of results worthy of discussion were indicated by the comparisons associated with past use of the Purdue Film Library. While the application of the quiz total score criterion yielded no differences among the treatment conditions, delayed recall scores were found to be significantly higher under the film learning condition among Film Library users with little or no previous knowledge of physics. A similar tendency might be pointed out among the students with some previous knowledge of physics although here statistical significance was not reached. Appropriate graphs of the means obtained using this criterion measure are shown in Figure 7. Thus, past experience with instructional films, as defined here by past use of the Purdue Film Library (PUFL), seems to enable some students to learn more from other films. This

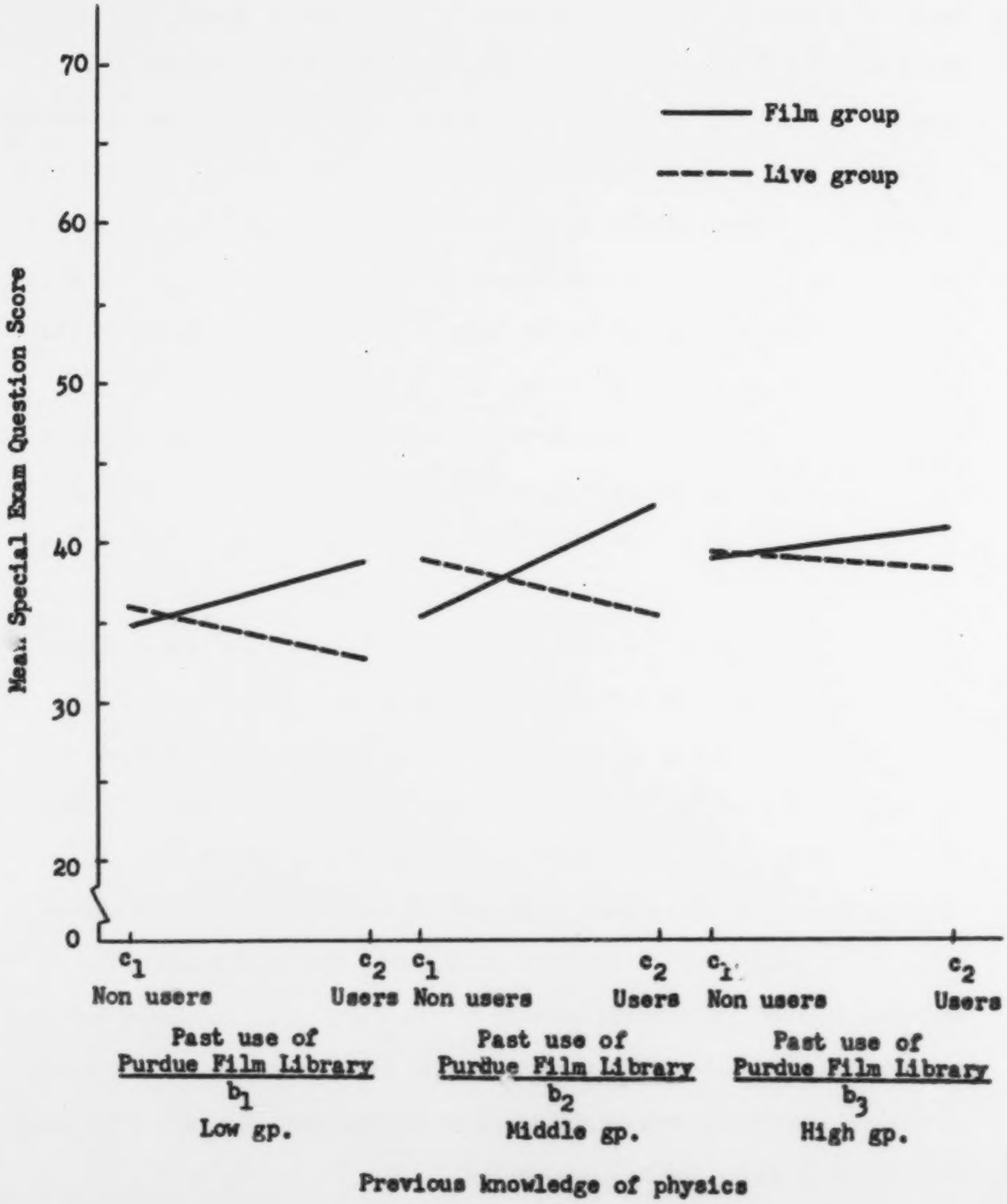
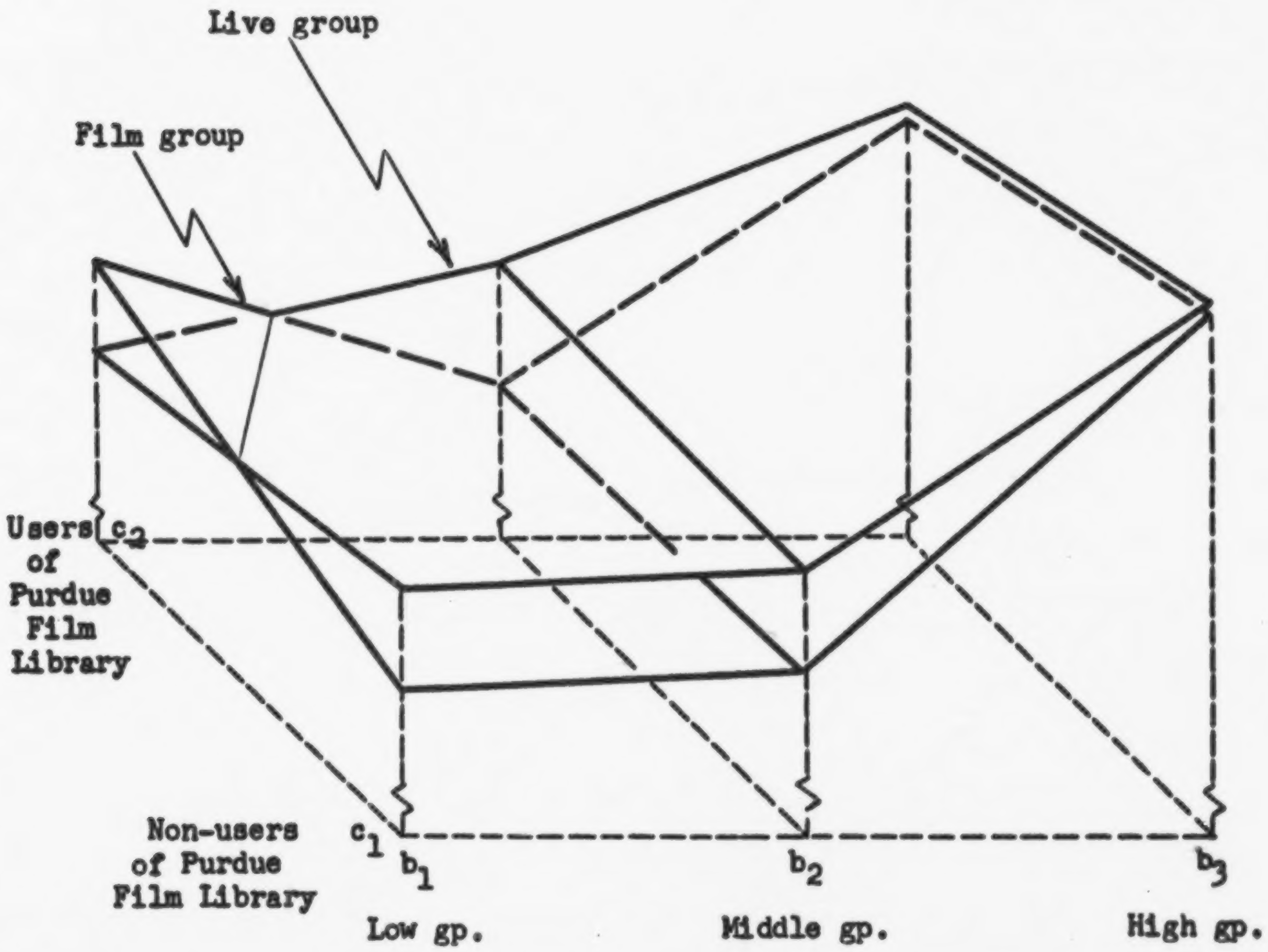


Figure 7. Graph of individual cell means for special exam question score using past use of Purdue Film Library as Factor C.

positive influence of past experience is particularly strong for students who command less knowledge of the subject matter before beginning the course. In fact, an inspection of Figure 7 indicates that the performance of low and average previous knowledge - film group students who are Film Library users almost equals or exceeds that of the high previous knowledge group. Possibly, previous experience in viewing and learning from films can be considered a substitute for extensive previous knowledge of the subject matter in this case. Since this finding existed only for delayed recall, it would appear that past experience with films enhances retention of material learned from film while causing no superiority of film learners over conventional learners on an immediate recall basis.

Considering the subtotal scores on the immediate recall criterion, the four large differences between various film and live groups which emerged seem to confirm and extend the practical significance of the above findings. To aid in the demonstration and interpretation of these relatively complex relationships, the means for the film and live groups have been shown as response surfaces for the first, second, and third stages of practice in Figures 8, 9, and 10, respectively. This three-dimensional graphic representation of the data was used because it provided a clear and concise summary of the findings. It should not be taken to mean that trend analyses or other formal methods for the study of response surfaces were applied, since it was felt that such treatment of these data would not be appropriate.

In Figure 8, which shows the means for quiz subtotal score (1-5), the planes representing the performance of film and live group subjects do not differ significantly from one another at any of the points


Live group
Film group
Users of Purdue Film Library
c_2
Non-users of Purdue Film Library
c_1
b_1
Low gp.
b_2
Middle gp.
b_3
High gp.

Previous knowledge of physics

Figure 8. Response surfaces of individual cell means for quiz subtotal score (1-5) using past use of Purdue Film Library as Factor C.

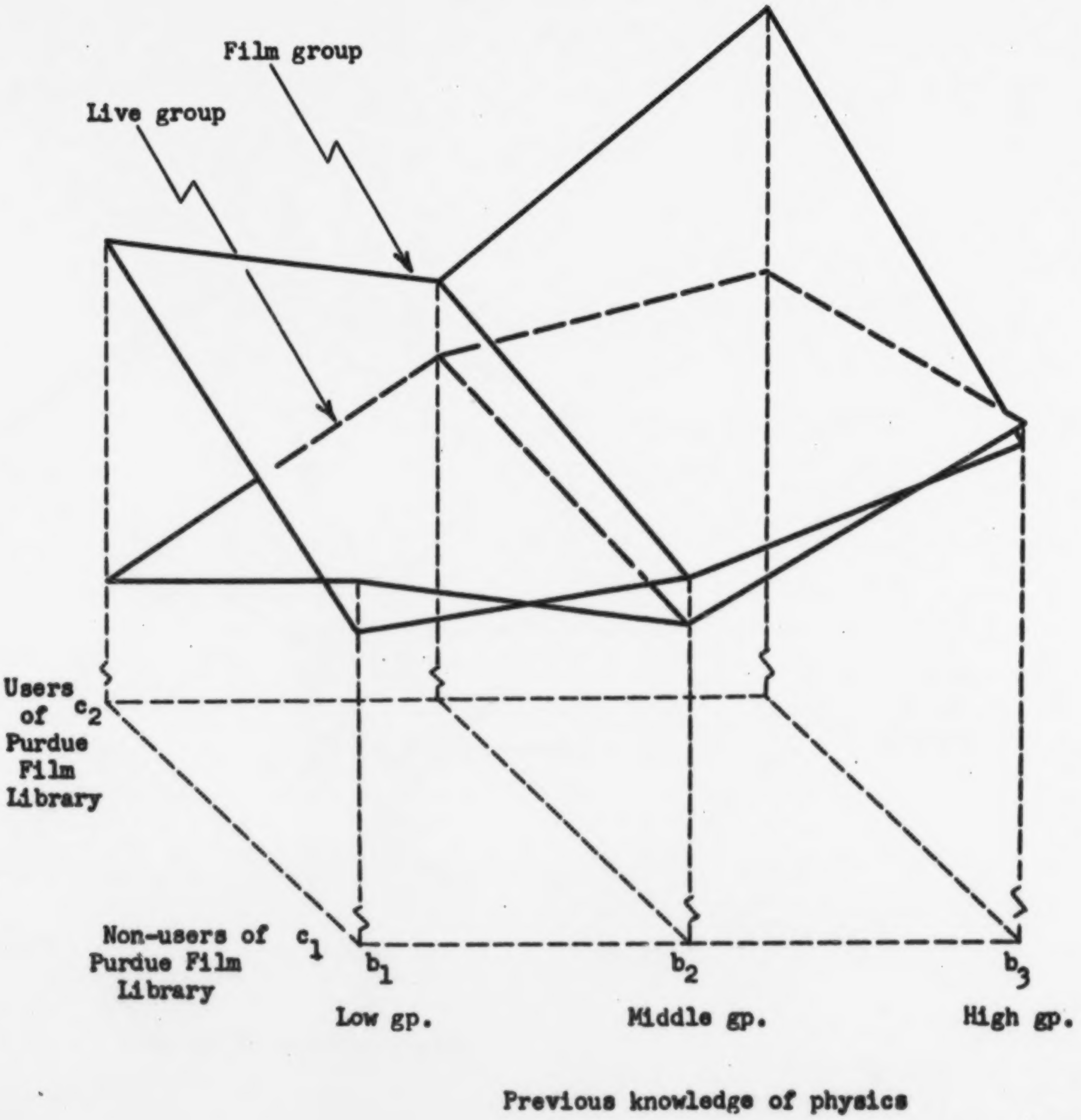


Figure 9. Response surfaces of individual cell means for quiz subtotal score (6-10) using past use of Purdue Film Library as Factor C.

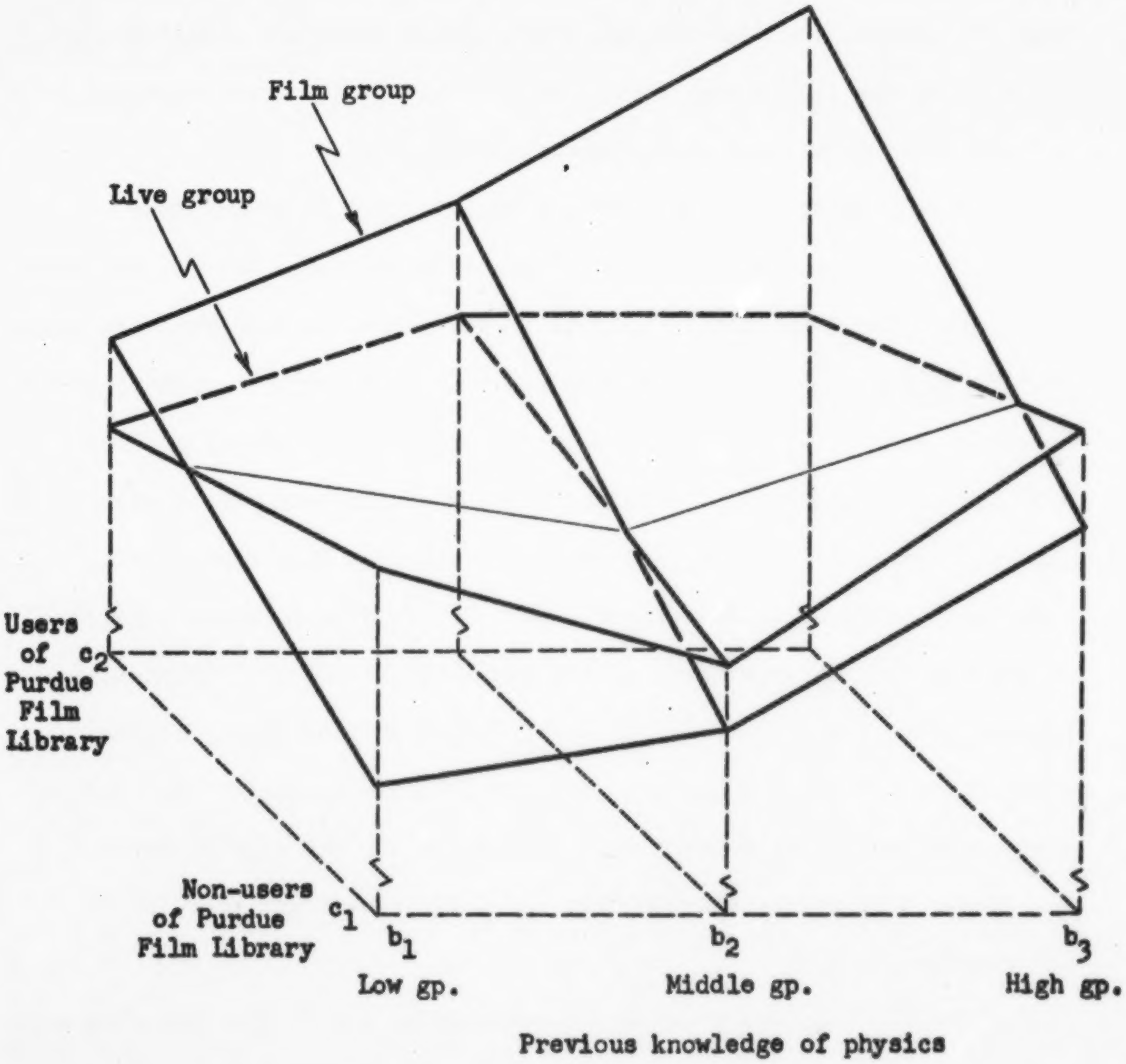


Figure 10. Response surfaces of individual cell means for quiz subtotal score (11-14) using past use of Purdue Film Library as Factor C.

indicated. With the exception of the slightly higher performance of film group students who used the Film Library and had no previous knowledge of physics, the conventional presentation means are consistently higher than the film group means. None of the differences found can be considered to be of practical importance however.

Figure 9 shows the means for the second stage of practice in viewing the physics demonstrations (quiz subtotal score 6-10). Although the elevations of the planes in this figure cannot be compared with those of Figures 8 and 10 since different tests were involved in each of the three criteria used, the relative differences between the film group and live group planes can be compared meaningfully among the three figures. Here, film group performance is significantly higher than live group performance for students who possessed no previous knowledge of physics but who were users of the Film Library (b_1c_2). Among Film Library users with high previous knowledge of physics (b_3c_2), those assigned to the film conditions again performed much higher than did those assigned to the conventional condition; but not significantly so. Other differences between film and live groups seem to be of no consequence.

The third practice stage is represented in Figure 10. The film vs. live difference among high previous knowledge - Film Library users is again shown to be relatively large although it did not reach significance. Here, live group performance exceeds that of the film group at all levels of previous knowledge of physics for individuals without past experience in the Film Library. The significant difference favoring the live group among low previous knowledge - no past experience students as indicated at b_1c_1.

From an inspection of Figure 8, it appears that past use of the Film Library, as opposed to no past use, is not related to differences in performance favoring the film learning condition before some practice in the course has been accumulated. The conclusion follows that past experience with instructional films does not provide film learners with any advantage which affects criterion performance in this relatively early stage of the course. Having viewed the first five physics demonstrations on film, however, may have provided practice which benefited these students. In Figure 9, some of these same film group subjects performed at a considerably higher level than their live group peers. The fact that all film groups did not improve (relative to their respective live groups) between the two practice stages shows that specific practice with the course films did not alone result in higher performance among film learners unless they had also made some use of the Film Library. After five more demonstrations were received, the trend for Film Library users with high previous knowledge of physics continued to favor the film learning condition while differences favoring the film groups at lower levels of previous knowledge no longer could be considered practically significant (see Figure 10). Further, in the third practice stage, the performance of film learners without past experience in the Film Library tended to fall below that of the individuals taught by conventional methods. This reversal might be attributed to the overall superiority of the live presentations for demonstrations #11 to #14 which was shown in a previous analysis or it might be due to some inhibiting effect of successive physics film presentations as the only kind of past experience with films available to these subjects.

Thus, continued practice in viewing the filmed physics demonstrations tends to alter the effects of the past experience variable on learning under the film and live presentation conditions. It is also obvious that past experience with instructional films (PUFL) tends to alter the effects of practice in the specific physics film series. Hypotheses suggesting an interaction between general past experience with instructional films and specific practice with similar types of instructional films seem to be forthcoming from this research but require more precise testing than is possible here. Apparently, the effects of past experience and/or practice in learning from films is far more complex than previous research has indicated.

The general conclusion drawn from these studies of the past use of Purdue Film Library variable is that past experience with instructional films is positively related to increased film learning while not being so related to conventional learning. This relationship may be more or less important depending on the extent of students' previous knowledge of the subject matter and on the amount of practice which has been accumulated by viewing films on similar subject matter.

The use of past experience with entertainment films, which represents students' past experience with entertainment films and public movies in general, provided one additional result of interest. The conclusion that film group student performance was superior to that of the conventional group subjects among individuals who frequently attended entertainment films is supported by the analysis of the quiz subtotal score (6-10) criterion. This interaction effect is clearly present in the graph of Figure 11. Since no differences were discovered using any of the other criteria, it may be that experience with entertainment films is of importance in learning from some instructional films (e.g. the films associated with quizzes #6 through #10) while being of little significance in learning from others. It is also possible that this finding arises from some idiosyncrasies in one or more of the films which is of no importance to learning from films in general. No such idiosyncrasies were immediately apparent in these films, however. It is difficult to rationalize the rather strange configuration of the data shown in Figure 11. The difference between film and live group performance of frequent moviegoers seems to be due more to a decreasing trend evident for the live learning condition between average and frequent theater attendance. Taken by itself however, the significant difference found is in the direction predicted by evidence from previous investigations.

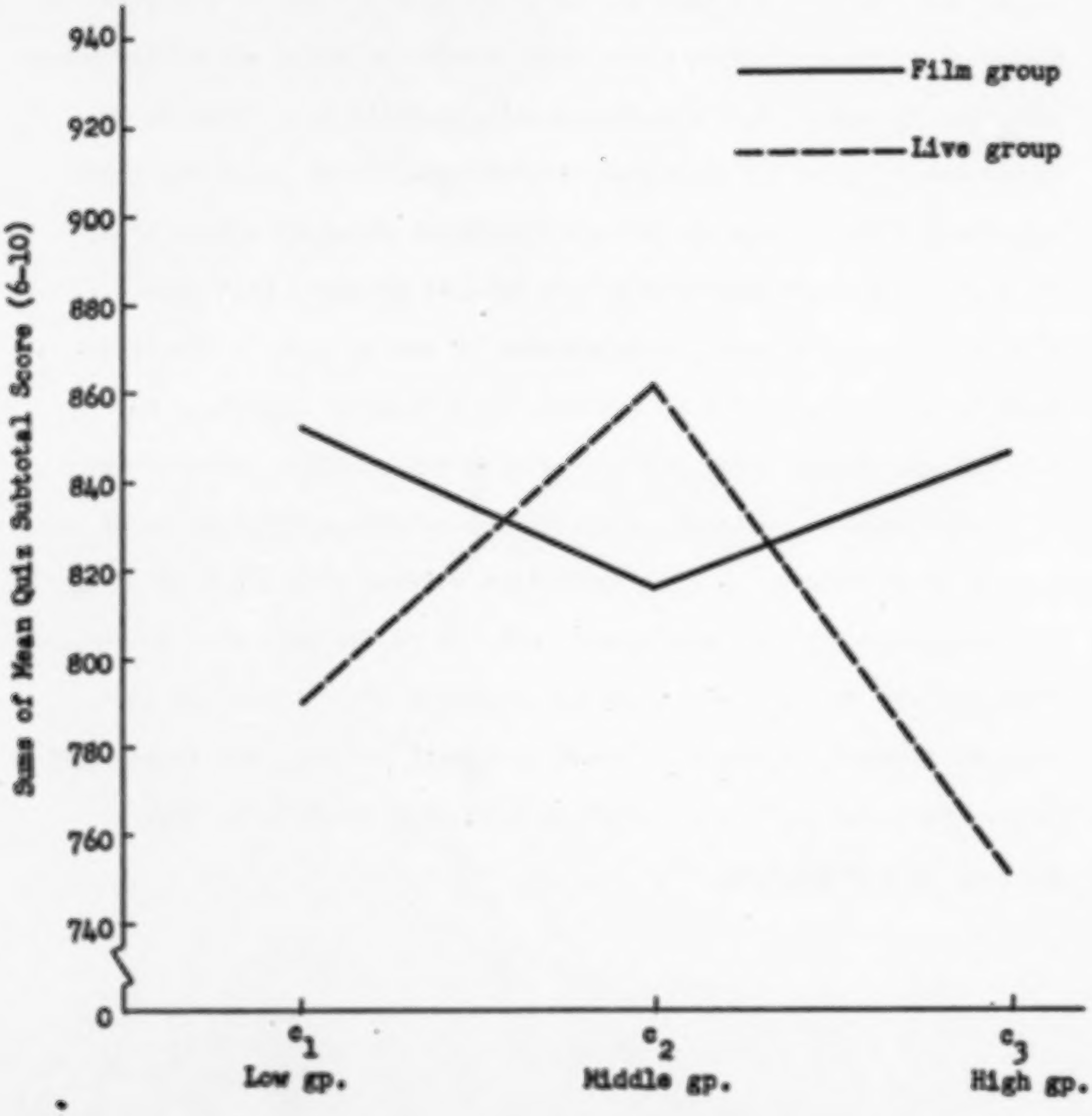


Figure 11. Graph of the AC interaction effect for quiz subtotal score (6-10) using past experience with entertainment films as Factor C.

CHAPTER VII

INTERRELATIONSHIPS

Analyses

This research has been premised on the belief that further understanding of learning from films will not arise without considering (1) the effects of many individual differences among learners on both film-mediated and conventional (control) learning and (2) the relationships existing among these individual differences. Evidence presented so far in this report has shown that a number of personal characteristics and abilities of the learner are differentially related to learning under the two conditions. These findings have been based, however, on separate analyses of each independent variable. It has not been possible to determine the extent to which two seemingly independent effects might be due to a single underlying relationship. Thus, the determination of the intercorrelations among the variables used is necessary to provide ground for more consolidated interpretation and understanding. In this chapter, data are presented which bear on this second question of concern in the present research.

While the original plans for the study provided for intercorrelation of those variables identified as significant, it was not known, of course, how many variables would be so identified. The matrix which resulted from the primary analyses contained 14 variables, including the five criterion measures. Because of the number of measures involved it was felt that factor analysis might offer a means of describing these interrelationships more succinctly. However, the matrix was not constructed, originally, to define a given domain for analysis. The variables were selected from four major areas of individual differences to represent adequately as many findings from previous research as was practically feasible. Essentially, they have in common only the fact that each was found to discriminate between film learners and conventional learners in some way. It is this common element which must be relied upon if a definition of the domain in question is sought.

The matrix of intercorrelations among nine independent and five dependent variables appears in Table 21. Each of these correlations was computed using all individuals for whom the pertinent data were available for that correlation. Although N therefore differed for each pair of variables, the resulting correlations were considered the best estimates obtainable from the data at hand. The number of observations on which each correlation was based also appears in Table 21, in the corresponding cells across the main diagonal. In generating the matrix, PUFL was treated as a true dichotomy (users vs. non-users). All other variables were continua. Pearson product-moment computational procedures were used in all cases.

The initial factorization of the correlation matrix was accomplished using a principal-factor solution. Communalities were estimated by the image-covariance method as suggested by Guttman (1953). This method provides lower-bound estimates through the use of the squared multiple correlations between each variable and all remaining variables while adjusting the off-diagonal correlations to preserve the Gramian

Table 21

Matrix of Intercorrelations (Above Main Diagonal) and Cell Frequencies (Below Main Diagonal) for Selected Independent and Dependent Variables

	AIF	A-GPP	R-GPP	PUFL	PXEF	AA	NA	VA	PKP	QTS	SEQS	QSTS (1-5)	QSTS (6-10)	QSTS (11-14)
AIF	-	.12*	.12*	.06	-.10	-.05	.03	.00	-.02	-.10*	-.11*	-.08	-.08	-.04
A-GPP	364	-	-.01	.01	-.01	-.05	.08	.09	-.04	-.03	.00	.03	-.05	-.04
R-GPP	364	376	-	.02	-.11*	.12*	-.05	-.01	.00	-.01	.05	.01	.02	.01
PUFL	378	376	376	-	-.11*	.01	-.06	.13*	-.04	.01	.00	-.01	.00	.09
PXEF	377	376	376	389	-	-.01	.09	.04	-.03	-.04	-.03	-.01	-.06	-.05
AA	414	369	369	383	382	-	.41*	.35*	.28*	.46*	.42*	.26*	.34*	.47*
NA	404	361	361	375	374	417	-	.26*	.21*	.33*	.27*	.20*	.27*	.22*
VA	402	359	359	373	372	415	417	-	.26*	.30*	.24*	.19*	.18*	.31*
PKP	421	376	376	390	389	430	419	417	-	.37*	.32*	.33*	.28*	.29*
QTS	421	376	376	390	389	430	419	417	437	-	.52*	.75*	.64*	.69*
SEQS	401	362	362	376	375	410	398	396	416	416	-	.33*	.40*	.46*
QSTS(1-5)	294	270	270	282	282	299	291	289	303	303	296	-	.30*	.36*
QSTS(6-10)	294	270	270	282	282	299	291	289	303	303	296	303	-	.42*
QSTS(11-14)	294	270	270	282	282	299	291	289	303	303	296	303	303	-

Where: PKP = Previous knowledge of physics
QTS = Quiz total score
SEQS = Special exam question score
QSTS(1-5) = Quiz subtotal score (1-5)
QSTS(6-10) = Quiz subtotal score (6-10)
QSTS(11-14) = Quiz subtotal score (11-14)
All other variables are as previously defined

* = Significant at .05 level.

properties of the matrix. The adjusted correlation matrix including estimated communalities and the initial, unrotated factor matrix may be found in Tables 66 and 67 in Appendix C, respectively. From an inspection of the obtained latent roots, five factors were selected for rotation. The cumulative per cent of variance accounted for by these factors was 94.7%; that for the first factor alone was 76.8%. The Carroll biquartimin oblique rotation was then applied to the five factor matrix. A discussion of this method of rotation has been provided by Harman (1960). The resulting, rotated factor loadings appear in Table 22 and the correlations between the five factors are shown in Table 23. Table 68, Appendix C gives the appropriate transformation matrix for the rotation.

One variable, the quiz total score criterion measure, was dropped from the correlation matrix before factorization and rotation because it was known to be linearly dependent on three other variables (i.e., the quiz subtotal scores). Its factor loadings were estimated from weighted averages of the loadings of other variables on each factor, the weights deriving from the correlations between each variable and the quiz total score.[8] These estimates appear in their appropriate positions in Table 22.

For purposes of interpretation, a lower limit for factor loadings was established below which the loadings were not considered meaningful. This limit was taken as the value corresponding to the .05 level of significance for an r with 200 degrees of freedom and was found to be .14.

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[8] A more precise method, such as that presented by Fruchter (1954), was not used since it would have yielded overestimated loadings in this case.

Table 22

Rotated Factor Loadings for Five Factors

	Factor				
Variable	I	II	III	IV	V
AIF	-.04	.02	.07	.22	.03
A-GPP	.01	-.02	.19	.03	.01
R-GPP	.00	.20	.02	-.02	.04
PUFL	.02	.11	.12	.03	-.08
PXEF	-.01	-.18	.06	-.05	.03
AA	.61	-.10	.12	.06	-.05
NA	.35	.05	.05	-.06	.24
VA	.39	.03	-.03	.15	.17
PKP	.40	.01	.10	-.13	-.04
QTS	.51	.02	-.01	-.04	-.01
SEQS	.56	.01	-.08	-.01	.00
QSTS(1-5)	.44	-.02	-.08	.00	-.02
QSTS(6-10)	.51	-.02	-.03	-.04	-.08
QSTS(11-14)	.53	.17	.01	-.15	.04

Table 23

Correlations Between Five Factors

	Factor				
	I	II	III	IV	V
I	-	.11	.01	-.10	.08
II		-	.05	.03	-.04
III			-	.06	.01
IV				-	-.35
V					-

Factor loadings which exceeded this value and which were therefore accepted as interpretable are underlined in Table 22.

Discussion

Factor I was by far the most prominent single factor and might represent general mental ability or academic achievement. All variables which would be expected to include an intellectual component loaded highly on this factor while, for the non-intellectual variables, the loadings centered closely around zero. The achievement measures displayed somewhat higher relationships with this factor than did the numerical and verbal aptitude variables. Previous analyses seemed to indicate general main effects of academic achievement, numerical and verbal aptitude, and previous knowledge of physics on the learning criteria. All of these effects now appear to result in part from the action of this single, underlying factor.

Factor II also included a criterion achievement component as indicated by the loading of quiz subtotal score (11-14). Considering the positive loading of responsibility, this factor could be viewed as some kind of academically-oriented responsibility. That frequency of attendance at entertainment films was found to be related negatively to this factor lends credence to the above interpretation. The independent variables responsibility and past experience with entertainment films were both found to interact with the film vs. live treatment conditions variable on one of the criteria. However, the correspondence between these two ANOV results which is suggested by this negative relationship in the structure of Factor II is not immediately evident. A comparison of Figures 3 and 11 shows that, while low responsibility students learned significantly more in the conventional presentation condition (using the quiz total score criterion), students reporting high past experience with entertainment films scored higher when placed in the film presentation condition (using quiz subtotal score for the second practice stage as criterion). While a negative correlation between responsibility and past experience with entertainment films may exist, it may be differentially affected when film vs. live learning and various criteria are considered. Thus, hypotheses concerning higher-order interactions among these variables seem to be not without foundation and are deserving of attention by future investigators. Further research might also consider the importance of some kinds of past experience with instructional films in this factor. Past use of the Purdue Film Library might have been expected to relate positively to an academic responsibility factor but the loading of this variable, while positive, was observed to be of borderline magnitude. In terms of individual correlations, it was found to correlate negatively with past experience with entertainment films.

Factor III must be defined by its loading for ascendancy only and is thus to be considered a unique factor. Although borderline loadings were obtained for past use of Purdue Film Library and academic achievement on this factor, these do not provide sufficient basis for a consideration of their implications. Apparently, ascendancy is not related to any significant extent to the other variables studied.

Factor IV displayed positive loadings for attitude toward instructional films and verbal aptitude but negative loadings for quiz subtotal score (11-14) and previous knowledge of physics, the latter being a marginal value. Assigning a name to this factor would rely on the highest loading, that for the attitude variable. This common factor does not seem to underlie the earlier findings for attitude toward instructional films and verbal aptitude however. The graphs of Figure 1 and 6 do not correspond meaningfully and it is doubtful that they are related to any practically important extent. The hypothesized interaction between attitude toward instructional films, mental ability, and learning, which was proposed in Chapter III and questioned in Chapter V, does not gain support from these findings.

Factor V may represent a more specific mental ability factor which is distinct from Factor I. Positive loadings were observed only for numerical and verbal aptitude. Since these variables might be viewed as measures of "purer" intellectual abilities than the achievement variables, their loadings here could indicate variance in intelligence which is not correlated with academic achievement. Some coincidence between the graphs of Figures 4, 5, and 6 may also imply that results discussed earlier for numerical and verbal aptitudes have a common source. While most of the intercorrelations among the five factors differed only slightly from zero, Factors IV and V were found to be correlated -.35. From these findings, it is believed that further research concerning the intellectual requisites of film and conventional learning would be profitable. In Chapter V, a comparison of Radlow's (1955) results with those of this research was made. Taken together, the two studies indicate that (1) specific mental abilities are related to film learning and (2) mental ability, more generally defined, is differentially related to film and live learning. Research combining and expanding the two approaches is needed. It is regrettable that measures of more specific aspects of mental ability could not be included in this investigation.

Two other hypotheses concerning individual variables are suggested by the data presented in this chapter. While neither are supportable by this research, it is felt that they should be offered for the consideration of future experimenters in this field. First, one variable, past use of Purdue Film Library, did not load highly on any factor. While its marginal loadings on factors dominated by personality variables have already been mentioned, attention might also be directed to its positive correlation with verbal aptitude. If some past experience variables are related to certain aspects of intelligence, then it is necessary to determine whether both voluntary past use of films and superior film learning are affected by intelligence and only incidentally related to one another or whether both intelligence and past experience are independently related to film learning. Second, a slight increase in the factor loadings on all factors was observed over the three stages of practice in the course. That is, some consistency in the differences in factor loadings of the three quiz subtotal score criteria seemed to be apparent. This effect could be due to chance, to differences in the three measures not related to practice, or to real differences in factorial structure related to practice. Research designed to detect differences in the factorial structure of learning in general and of film learning in particular over a series of trials or practice stages could add significantly to present knowledge of these phenomena.

It should be pointed out that many of the initial intercorrelations and the final, rotated factor loadings were very low. The communalities for these variables show that little common variance has been accounted for by the factors established. Therefore, aside from the intercorrelations among the aptitude and achievement variables and Factor I which emerged from them, interpretation of these results must be considered extremely tentative. The addition of even a few other variables might radically change the factorial structure observed. The factor analysis has thus been presented as a description of the variables as they existed in this situation and should not be construed as a factorial study of any well-defined domain.

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CHAPTER VIII

CONCLUSION - STUDY ONE

Summary of Results and Conclusions

This research was undertaken to study the effects of personal characteristics of the learner in relation to learning from instructional films and from conventional, live presentations of the same material. Previous findings had indicated that a number of learner variables might be important in this regard but few studies had investigated more than one or two variables at a time and many had considered only film-mediated learning. The 14 audience characteristics included in this investigation were chosen to cover as adequately as possible the range of variables suggested as important by previous research. Each was treated in combination with different levels of previous knowledge of the subject-matter as well as the film vs. live learning conditions. The aim of the statistical analyses was to uncover differences in amount learned under the different instructional treatments within specific substrata of the population defined by the personal characteristic and previous knowledge variables. An attempt was also made to determine the interrelationships among those learner characteristics found to be related to learning.

The general conclusion arising from this research must be that personal characteristics of learners determine, to a significant extent, the amount of learning derived by individual members of the audience in a given learning situation. Seven of the learner variables studied were found to interact significantly with the film vs. live presentation conditions. These were: attitude toward instructional films, ascendancy, responsibility, numerical aptitude, verbal aptitude, past use of the Purdue Film Library (one of two measures of past experience with instructional films), and past experience with entertainment films. These and one other variable also exhibited other relationships which, while not statistically significant, were suggestive of differences worth further consideration. This additional variable was emotional stability. Thus, a number of individual differences among learners are differentially related to film learning and conventional learning. Although some of these individual differences are correlated, in only one case are the effects of two variables apparently the result of a common underlying factor.

The results of the statistical analyses carried out in this investigation are summarized in Table 24, in symbolic form. All differences between film and live group means which were considered of practical importance are included in the table. Those that achieved statistical significance are so noted.

With respect to individual learner variables, some specific conclusions may reasonably be drawn from these results, as follows.

1. Conventional, live presentation of the physics instructional material facilitates more learning, as measured by immediate recall, than does filmed presentation among students displaying unfavorable attitudes toward instructional films and possessing little previous knowledge of physics. Students without

Table 24

Summary of Results for All Independent Variables Used as Factor C

	Dependent Variable				
			Immediate Recall		
Independent Variable Used as Factor C	Immediate Recall	Delayed Recall	Practice Stage I	Practice Stage II	Practice Stage III
Attitude toward instructional films	$L_{11} > F_{11}^{*}$ $F_{13} > L_{13}$		-	-	-
Attitude toward entertainment films			-	-	-
Attitude toward physics			-	-	-
Ascendancy	$L_{.3} > F_{.3}^{*}$ $F_{.1} > L_{.1}$		-	-	-
Responsibility	$L_{.1} > F_{.1}^{*}$ $F_{.3} > L_{.3}$	$L_{.1} > F_{.1}$	-	-	-
Emotional Stability		$L_{.1} > F_{.1}$	-	-	-
Sociability			-	-	-
Profile Total Score			-	-	-
Numerical Aptitude	$L_{13} > F_{13}^{**}$ $F_{31} > L_{31}$	$L_{23} > F_{23}^{*}$ $F_{31} > L_{31}$	-	-	-
Verbal Aptitude	$L_{23} > F_{23}^{*}$		-	-	-
Academic Achievement			-	-	-
Past Experience with instructional films					$L_{..} > F_{..}^{*}$
Past Use of Purdue Film Library		$F_{12} > L_{12}^{*}$ $F_{22} > L_{22}$		$F_{12} > L_{12}^{*}$ $F_{32} > L_{32}$	$L_{11} > F_{11}^{**}$ $F_{32} > L_{32}$
Past Experience with entertainment films				$F_{.3} > L_{.3}^{**}$	$L_{..} > F_{..}$

Where: F_{ij} = Film group mean in cell $b_i c_j$
L_{ij} = Live group mean in cell $b_i c_j$
Where b_i = low (1), middle (2), or high (3) previous knowledge of physics and c_j = low (1), middle (2), or high (3) personal characteristic. Dot (.) in place of i or j indicates sum over those levels. One personal characteristic (past use of Purdue Film Library) has only two levels of c, c_1 = no use, c_2 = some use.
$>$ = greater than
* = significant at .05 level
** = significant at .01 level
(no asterisk) = practically but not statistically significant

previous knowledge of physics but with relatively favorable attitudes toward instructional films tend to learn more from filmed presentations.

2. Students characterized as ascendant or assertive in their relationships with others exhibit more immediate recall when learning is mediated by conventional methods while less ascendant, passive individuals tend to gain more from instruction mediated by film.
3. Students who are irresponsible or who lack determination perform at a higher level, in terms of both immediate and delayed recall, in conventional learning situations while instructional films appear to be more appropriate for responsible, persevering individuals.
4. Less emotionally stable individuals tend to retain learned material more adequately if it is originally presented by conventional rather than filmic means.
5. Conventional learning conditions are superior to film learning conditions, on immediate recall, among students with high numerical aptitude but little previous knowledge of physics and, on delayed recall, among students with high numerical aptitude and average previous knowledge of the subject matter. With both immediate and delayed criteria, film presentation is superior to live presentation for individuals with relatively low numerical aptitude but with high previous knowledge of physics.
6. Among students exhibiting high verbal aptitude and average

previous knowledge of physics, live instruction is superior to film instruction, in terms of immediate recall performance.

7. Past experience with instructional films, as measured by self-reported past use of the Purdue Film Library, results in higher retention of material learned from films rather than from conventional instruction. This effect of past use of films, while not significantly related to overall immediate recall performance, is of import in the later stages of practice in learning from a series of instructional films. That is, the accumulation of practice in learning from the earlier films in the course series enhances the effect of the past use variable on immediate recall learning from later films in the series.
8. For some of the films used, frequent past experience with entertainment films is associated with higher immediate recall learning from those films than from conventional presentation of the same material.
9. Previous knowledge of the subject-matter taught, in this case physics, is positively related to amount learned and retained, regardless of the method of presentation used. Differences in previous knowledge of the material affect observed relationships between some personal characteristics of the learner and the instructional medium employed.
10. Hypotheses suggesting a differential effect on film and conventional presentational media of attitude toward

entertainment films, attitude toward the subject-matter presented, sociability, total personality self-evaluation, academic achievement, and past experience with instructional films (as measured by self-reported categorical judgments of frequency of exposure in high school and college courses) cannot be supported by data collected in this situation.

11. While no overall differences were found between the filmed and the live presentations, the performance of the live group students on immediate recall quizzes #11 through #14 was superior to that of the film group students. Thus, the films associated with these quizzes appear in general to be less effective instructionally than their conventional presentation counterparts.
12. Among the learner variables found to be related to film and live learning differentially, five factors can be identified. From the loadings of numerical aptitude and verbal aptitude on these factors, it may be suggested that the results reported for these variables may arise from the common factors which underlie both measures. While all aptitude and achievement variables used are positively related to one another in one common factor, the non-intellectual variables appear to be relatively independent of this achievement factor and of each other.

Implications and Limitations

The specific conclusions listed above have been discussed in the chapters from which each was drawn. There are several more general implications and limitations of this research, however, which deserve consideration.

Instructional films and the conditions under which they are usually used differ inherently from conventional classroom presentation methods and practices. The findings reported here suggest that these differences give rise to the action of personal variables in the learner which inhibit learning in some students while facilitating the learning of others. Apparently, there are large and numerous differences between the correlates of learning from the filmed physics demonstrations and the conventionally presented demonstrations with which they were paired in this situation. It is not known whether the causes of these effects lie in the specific filmed and live demonstrations used here or whether students could be expected to respond similarly regardless of the material presented or the film vs. live treatments employed. Some of these results are in agreement with those of previous research using different material and presentation conditions. Also, the films, while highly technical, were factual demonstrations without dramatic embellishments or excessive special effects. They were presented in a straight-forward, uninterrupted showing which was integrated with other course content. It does not seem unreasonable to assume, therefore, that this situation is fairly similar to other common film usages. It is believed that the major findings of this investigation refer to a more generally conceived film learning vs. conventional learning difference rather than to this particular learning task exclusively.

Generalization is understood to be limited to some extent by the films and film utilization involved in this study however. With other films used in different ways, some of the relationships noted might disappear while others might emerge. Users of instructional films need not conform to traditional film production and presentation techniques. May and Lumsdaine (1958) have shown, for instance, that questions can be spliced into films to serve a motivating function and to induce active participation by students. Other research has attempted to construct films and video tapes in a manner similar to that used in the teaching machine-programed instruction area (Lumsdaine, 1959; Gropper and Lumsdaine, 1961a, 1961b). Differences in the construction and utilization of the same film might drastically change the personal characteristic prerequisites to efficient film learning but consideration of these differences is beyond the scope of this research.

The possession of special abilities or characteristics which facilitate learning from films has been called "film literacy" (Hoban and Van Ormer, 1950). Previous research has suggested that this variable includes perceptual abilities which aid in interpreting cinematic techniques and that it is related to past experience in viewing and learning from films. If film literacy arises only from practice in learning from films, then the results of this investigation support the contention that learners become more film-literate through film experience. The process should then be viewed as the formation of a film learning set (as inferred from Harlow, 1949). But, from this research, there appear to be other variables which might be considered contributors to film literacy also. Responsibility, for instance, was found to be related somewhat to the past experience variables and would be one of the variables used in the selection of superior film learners. Since any group of superior film learners would be expected to include film literate individuals, it is possible though not logically necessary that responsibility and film literacy would be correlated. Pending more definitive evidence, this research suggests that the film literacy concept should include all learner variables the possession of which has been shown to enhance instructional film learning.

It has already been implied that some combination of predictor variables might be used to select individuals who are especially equipped to learn from films. Although the composition of such a battery might differ depending on the types of films to be used, the ability to discriminate superior film learners from others would be useful wherever alternate sections of courses or training programs exist. In addition to providing instruction tailored to individual needs and abilities in this way, savings in time, costs, and staff needed might accrue from such optimum use of film. Audience profiles derived from the predictor battery might also be of value in the planning and production of films, so long as the relationships between various film variables and the pertinent audience variables were known. Target audiences have in the past been only generally defined in terms of age, educational level, etc. If important learner variables are at all specific to characteristics of the film, then these film variables, which are under the control of the producers, may be manipulated to advantage. A further possibility for upgrading filmed instruction exists if some audience characteristics may be altered through training. Although training in interpreting optical effects in films has been attempted previously without success (Mercer, 1952), this study, of the more general attitude and past experience variables at least, suggests that superior film learners may be developed to some extent through "vestibule" training programs. It is not difficult to envision the futuristic instructional systems, streamlined by the application of new media, which may develop in industry and the military as well as in formal education. Training for "media literacy" (which should be defined more broadly than the film literacy concept previously referred to) might be an integral part of these systems.

The finding that the comparative effectiveness of film-mediated vs. conventionally-mediated instruction depends in part on characteristics of the audience which have often been ignored holds important implications for research in newer media as well as in film. The earlier film studies treated the audience as a mass which, while composed of individuals, could be viewed as a unit and described by a single index or average score. It has been shown here that two methods of presentation may differ radically in instructional effectiveness within specific substrata of the "audience mass." An inspection of the data indicates that these differences are masked by film group - live group main effects. Thus, statements concerning the relative effectiveness of different presentations must include qualifications concerning the kinds of subjects involved which need to be much more detailed than the simple biographical data usually offered. Studies of televised instruction still treat audiences as units. An extremely large number of investigations have failed to detect differences between televised and conventional instruction of various sorts and this "overabundance of nonsignificance" has become a point of concern in the field. One possible explanation may be that the important differences, if they exist at all, are averaging out in overall comparisons. Explorations designed in a manner similar to this investigation seem worthy of consideration. It would not be unreasonable to apply this approach in the teaching machine-programed learning area also. Virtually no studies in televised or programed instruction have included any personal characteristics of the learner other than a rather grossly defined mental ability variable.

Aside from limitations imposed on generalizations from these findings which have already been mentioned, some other limitations should be indicated. These are discussed here to provide more basis on which to evaluate the importance of this research and to aid future investigators in designing experiments aimed at furthering understanding of the issues involved in this area.

First, in large studies in which many statistical tests are applied to the same data, a question always arises concerning the number of differences judged significant but due to chance alone. Further, in this investigation, importance has been attached to some differences which, while practically large, were not statistically significant. While many more significant effects were found here than could have been expected to occur by chance, complete replication with new data would provide the best insurance against accepting chance differences as real. Rather free interpretation of the findings has been permitted since it was believed better to draw inferences later proved false than to discard and thus bury potentially important implications in this relatively new direction of media research. There is little justification however for allowing any one finding from any single experiment to stand alone for long.

Second, when gross classifications are used to replace continuous independent variables real differences in means on these variables may occur within the grossly equal subgroups in one classification level. In this study, an informal check was made on personal variable means between film and live group subjects within specific levels of the personal variables. Since no noticeable differences were found, it seems unlikely that the findings of this investigation were affected by this source of variation. Because the cell frequencies differed consistently for the past use of Purdue Film Library variable however, this analysis was changed to take the individual frequencies into account. Presumably, the live group students had tried to compensate (unsuccessfully) for the difference in presentation treatments. On the ascendancy variable, a somewhat similar trend was noticed. Here, the analysis was not modified since it was considered unlikely that a basic personality trait would really be altered by the treatment conditions imposed. No other variables exhibited this difference in cell frequencies so that, generally, chance fluctuations in frequency could be disregarded. The intellectual variable analyses were changed since these measures obviously correlated with previous knowledge of physics.

Third, this study suffered to some extent from its tangential relationship to another research project. Time was not available for more intensive and extensive measurement of learner variables and the treatment conditions had necessarily to be constructed within the confines of other objectives. Future investigators should seriously consider (1) the establishment of equal cell frequencies among the treatment groups, (2) inclusion of measures of more specific mental abilities as well as other personal variables which might suggest themselves, (3) more precise measurement of past experience variables, (4) formal inclusion of practice effects within a series of films as an experimental variable, (5) formal trend analyses over equally-spaced levels of the personal variables used, and (6) equivalent criterion measures of immediate and delayed recall. Replications and/or extensions of this research which could incorporate these suggestions might add definition to many of the findings which have here been only tentatively advanced.

STUDY TWO

FILM CHARACTERISTICS

CHAPTER IX

BACKGROUND AND OBJECTIVES

Previous Research

The literature concerning film production variables was surveyed for Study Two in a manner similar to the review of research on audience characteristics completed for Study One. A formal presentation of this second survey, together with reference citations, was not attempted however. Instead, it was decided to include only a brief overview and critique of previous research and discussion in this area. A relatively detailed summary of one previous study has been incorporated into this chapter since its purposes and procedure closely paralleled those of this study.

There have been many investigations of the effects of film production variables on learning from instructional films. Most of these studies have shared common objectives, namely, to determine the contribution of isolated film characteristics to a film's instructional effectiveness and to develop recommendations based on this determination for use by producers. They have also, in general, shared a common methodology. Two or more versions of the same film have been developed to vary the characteristic(s) singled out for study and the amount learned from each version has been systematically compared.

Hoban and Van Ormer (1950) have summarized much of this literature. Their outline of variables considered important in film production is presented as follows.

1. Audience involvement factors.
    - a. General involvement in terms of physiological response or self-reported experience.
    - b. Identification with main characters and situations portrayed.
    - c. Familiarity with activities and situations portrayed.
    - d. Subjective camera angle or point-of-view photography.
    - e. Anticipation or expectancy of material or situations to be presented.
    - f. Participation or overt practice during the film, including the answering of questions spliced into the film.
    - g. Dramatic vs. expository format.
    - h. Cartoon vs. live photography.
2. Picture and sound.
    - a. Visual vs. auditory presentation of information.
    - b. Pictorial vs. verbal presentation of information.
    - c. Emphatic devices, including general emphasis of points and use of special attention-gaining and attention-directing devices.
    - d. Color vs. black and white.
    - e. Verbalization, including difficulty of vocabulary, words per minute, and time-phase relation between picture and sound.
    - f. Film music.
3. Other film structure elements.
    - a. Repetition, including both scene and commentary repetition within the film.

b. Rate of development.

c. Introductions and summaries in the film.

Research on these variables has provided useful information about the importance of production techniques to instructional film effectiveness and has offered some guidelines for appropriate use of these techniques. Some basic understanding of the various influences of films on complex human learning has been gained. But a number of problems and shortcomings exist in this previous work and these should be recognized and overcome if possible. There are at least three important distinctions concerning production variables which do not seem to have been made. Clarification of these distinctions might aid considerably further investigation and further understanding of the structure of films and the bases of individual differences among viewers in response to them.

One distinction which has not been adequately made concerns the _number_ of variables included for study in individual investigations. Film production characteristics have been treated as analysis of variance main effects by comparisons between different versions of the same film. But main effects are meaningless in the presence of interactions and interactions between film variables have not, in general, been studied. While some researchers have attempted to capture these relationships by developing many versions of films to incorporate all, or almost all, combinations of film variable levels, many limitations have hampered these attempts. Not the least of these restrictions is the considerable time, cost, and number of subjects required for the construction of all possible comparisons. The number of potential variables which might be considered, while probably finite, is practically unmanageable within the limits of most research projects. Another approach might, therefore, be applied to this problem with profit. While the experimental control provided by the use of alternative versions of the same film is both admirable and necessary for some experimental purposes, it might be advantageous instead to view a given collection of films as a sample of individuals. Intercorrelational and factor analytic approaches have become commonplace to the study of individual differences among experimental subjects of all kinds. Why should the study of individual differences among instructional films not be pursued in a similar manner? This is not to suggest that factor analysis should supplant analysis of variance in instructional media research; the two are actually complementary and related approaches. The one has been neglected for the other, however, and this is an unnecessary narrowing of the field available to the researcher.

A related concern here is that important variables may have been overlooked. Hoban (1960, p. 104) has emphasized this point by stating that:

> "Like all arts, the 'art of teaching' is highly creative in many respects. So are the arts of film-making, television,production, and other activities having to do with the production of a product. The creative nature of film-making increases the difficulty of film research, since (a) independent variables are embedded in an art-form, and (b) the art of film-making itself is a variable. In the creative process, the artist, knowingly or unknowingly, may introduce additional variables which have not yet been identified as variables in theory or research."

Treating films as individuals, it is possible to quantify hypothesized aspects of specific existing films and to relate them to one another correlationally among films, just as human abilities have been hypothesized, measured, and related among individuals in the work of Thurstone, Guilford, and others. An area of research which might aspire to the name "cinemetrics" or, more generally, "mediametrics" can be easily conceived to parallel the field of psychometrics. While such an approach, like the more traditional comparative effectiveness approach, is not without its difficulties, it is believed that a significant broadening of research effort, with correlated extensions of understanding, might be forthcoming from its application.

A second distinction arises from the foregoing discussion which concerns the kinds of variables to be studied. As the statement quoted from Hoban suggests, an instructional film is an extremely complex combination or aggregate of variables. It is both a stimulus aggregate and a perceptual aggregate, however, and this psychophysical parallelism is methodologically important. The distinction represents a basic question in perception psychology. While it can be treated only summarily here, it has been fully explicated by Allport (1955).

An individual learner is shown a film from which he extracts and retains information. He then responds to questions on an achievement test which measure the extent of his learning. These responses, from groups of individuals for numbers of films, are also used to determine the effects of film production variables on learning. But what precisely are the bases in the film for these responses? The film may be considered an objective experience in terms of its sensory input to the eye and ear. It is also a subjective experience in terms of the percepts invoked in the observer by the sensory input.

In quantifying film variables, either aspect of film experience may be concentrated upon. The former view has been called the physicalistic approach and may be characterized by the question: "What are the facts about the film?" The latter view has been called the phenomenological approach and may be characterized by the question: "How does the film appear?" Film experience may thus be described in two ways and the resulting descriptions may or may not be comparable.

The term "veridicality" has been used to refer to correspondence between the physicalistic and phenomenological structure of experience. It represents a validation of percepts against independent measures of stimulus attributes. While veridicality is actually a continuum, it is convenient to refer to the cases in which there is correspondence between the two descriptions as veridical and to the cases in which this correspondence is lacking as nonveridical. Applied to films, this concept should be enlarged and altered somewhat from its most common usage. All film experience is illusory and, thus, nonveridical but it may be useful to distinguish among film attributes and variables on this dimension. Veridical film variables are those of which the viewer is aware and to which he could readily apply a verbal label or description. They are the obvious characteristics which may be easily attended to and perceived for what they are. Nonveridical film variables, on the other hand, are those which are illusory or which, while experienced, are not generally attended to or verbalizable. For example, the use of cuts, dissolves, zooms, split screens, slow motion, etc. are nonveridical variables in this sense while color vs. black and white, repetition of scenes, inclusion of introductions and summaries, dramatic vs. expository format, etc.

are veridical variables. Some variables, admittedly, can be classified into one or the other category only if their use in a specific film or film comparison is decided.

Thus, film variables may be viewed physicalistically or phenomenologically and may be considered veridical or nonveridical on the basis of the comparability of the two views. Reviewing the list of variables studied by previous investigations, it is contended that the vast majority are either phenomenologically defined or, if physicalistically defined, are veridical in nature. Physical components of nonveridical variables have generally not been considered. This omission from previous research requires rectifying since, as Gibson (1959, p. 463) has suggested, "Conscious perception...is not a prerequisite to behavior...Behavior [e.g., learning] can go on independently of such awareness and still be more or less specific to the environmental [e.g., film] situation." It may be just these variables that underlie the phenomenon of film literacy, which may be hypothetically defined here as those perceptual abilities required in viewers to "read" and to derive meaning from the filmic stimulus aggregate.

The third distinction to be made is related to, and a combination of, aspects of preceding discussions. Previous research has been concerned with film production variables considered in isolation as main effects. Also, audience variables, it was suggested in Study One, have been studied only as main effects. If the purpose of instructional media research is to understand the bases of media learning, however, it must concern itself with interactions both within film and audience variable domains and among them. Some film variables may affect learning only among certain kinds of individuals. Conversely, some learner variables may be important only for films employing certain types of production variables. The relation of these two matrices is obviously difficult since they are not immediately conformable. Some means exist for relating them, however, and these should be exploited.

The O'Connor Study

One previous investigation deserves singling out for detailed summarization since its approach is similar, up to a point, to that taken in the study presented in this report. Many of the variables are common to both studies, although the kinds of films and the experimental subjects differ considerably.

O'Connor (1950, p. 271) addressed himself to "...the task of analyzing a classroom presentation into its sign elements, that is, elements of meaning, the elements in the system of communication through which the student gets the information which the teacher presents." His purpose was to dissect classroom film presentations into unique elemental variables, to intercorrelate these, and to relate each to two measures of instructional effectiveness: 1) student performance on achievement tests, and 2) judgments of educators. Instructional film was not the primary interest. Rather, motion pictures were acknowledged as convenient records of teaching presentations which were readily available for analysis. The films used were commercially produced sound motion pictures, however, not simply filmed records of live presentations.

A series of 27 films was presented to groups of elementary school children and appropriate achievement tests were administered after each presentation. Scores on these post-tests were then used to determine a mean student performance index for each film which served as the principal criterion measure. While this procedure thus relied on different tests to produce a single ranking of the films, it was believed that a reasonably sound measure was obtained. Extraneous variance introduced by differences in individual test validity and reliability could be considered randomly correlated with the elemental film variables. Further, influence on the resulting correlations from this source would act only to reduce the estimates of the true correlations making it less likely that a chance relationship would be accepted as real. The second dependent variable was obtained from ratings of instructional effectiveness on a three-point scale, made by the Committee on Motion Pictures in Education, American Council on Education, for 24 of the films under investigation.

No criterion reliability estimates or correlations between student performance and measures of intelligence or previous knowledge of the subject-matter were reported; however, familiarity ratings were obtained for each scene of every film from an experienced elementary school teacher. These judgments were based on whether the scene in question could be considered within the previous experience of 50 percent of the fourth grade pupils in Madison, Wisconsin. A partial correlation of .03 was found between these ratings and the student performance criterion, with differences in school grade level of the subjects partialled out. This finding was taken to mean that adjustment of the performance criterion for previous familiarity with the presentations was unnecessary. For all further analyses however, school grade level was partialled out of the student performance measure.

A total of 21 film characteristics were measured for every film. Ten of these yielded correlations of at least .35 with one or the other criterion. These correlations, together with intercorrelations among selected film variables are presented in Table 69 as extracted from O'Connor (1950, pp. 278-279). The multiple correlation between the student performance criterion and seven predictor characteristics was reported as .80. Two variables seemed to dominate this multiple correlation however. These were nouns with a concrete referent and words with a personal referent.

The author provided several specific recommendations concerning the individual film variables found to be significantly related to instructional effectiveness and concluded that "...the effective teaching presentation (1) uses communication signs with referents upon which there is universal agreement, and (2) presents them in a fashion that provokes a response from the student" (p. 281). The terms "iconicity" and "salience" were used to refer to these two findings, respectively.

Iconicity was defined as the degree of reality or concreteness associated with the visual or verbal content of the films. O'Connor indicated that, at least in terms of face validity, five variables might be considered measures of this dimension. These were: scenes reproducing a visual experience, nouns with a concrete referent, nouns with a universal referent, number of affixes per 100 words, and demonstrated statements. Table 69 reveals some apparent clustering of these

Table 69

Selected Intercorrelations among Film Characteristics and Film Effectiveness Criteria
Reported by O'Connor (1950)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Student performance criterion	-		.35*	-.47**	.45**	.35	-.36*	.59**	.49**	.27	.29	.58**
2. Expert judgment criterion		-	.24	-.42*	.25	.33	-.18	.33	.53**	.41*	.36*	.28
3. Scenes reproducing a visual experience			-	-.21	.32	.36	-.27	.24	.47			
4. Ratio of words to scenes				-	-.39	-.12	.10	-.13	-.55			
5. Words with a personal referent					-	-.01	-.02	-.08	.57			
6. Demonstrated statements						-	-.48	.57	.20			
7. Affixes per 100 words							-	-.57	-.13			
8. Nouns with a concrete referent								-	.13			.90
9. Dramatic rating									-			
10. Ratio of scenes to film time										-		
11. Scenes of human activity											-	
12. Nouns with a universal referent												-

* = Significant at .08 level
** = Significant at .02 level

variables which might be indicative of a factor of iconicity. Similarly, a salience dimension might be measured by three variables: words with a personal referent, ratio of words to scenes, and dramatic rating. A definition of this aspect of the films was couched in terms of attention-gaining or holding power or degree of attention promotion. It is interesting to note in Table 69 that while both of these clusters seem well defined and both appear to be related to the performance criterion, only salience measures are related to the expert judgment criterion. This finding may have important implications concerning the general practice of film rating and reviewing by panels of experts.

In emphasizing the implications of his findings, O'Connor suggested that, "...presented materials that have high iconicity are partially learned before perceiving them. In contrast to the presentation that connotes, that generalizes, that deals in restricted meanings, the presentation that makes use of communication signs with universally-agreed-upon referents is half-learned before hearing [or seeing]" (pp. 282-283). With regard to salience, he stated that "...it is highly probable that a presentation made without getting an active mental response would not be recalled" (p. 283).

The variables studied by O'Connor can be considered, for the most part, physicalistically defined and nonveridical in nature. As indicated earlier in this chapter, it is just these variables which have not received attention commensurate with their importance. If factors consisting of physical variables could be identified and defined in perceptual terms, understanding of the basic issues in learning from films might be advanced. O'Connor's study suggests that such a quest may not be in vain.

Objective of the Study

The objective of Study Two was to investigate the importance of physical film production characteristics as they relate to the effectiveness of instructional films. The study was designed as an exploration of individual differences among existing instructional films with a view toward defining the underlying physical dimensions on which these films differ. Special emphasis was placed on variables isolated by one previous investigation, although other film characteristics suggested by rational considerations and by observation of the films were included. It was hoped that such research might provide more adequate bases for describing films and for developing recommendations useful in film production. It was further hoped that some understanding of the relationships between audience variables and film production variables as they affect learning could be gained.

Answers to the following questions were sought:

1. What are the elemental physical film variables which differentiate between the films in an existing series of instructional film presentations?
2. What dimensions or factors of film production can be hypothesized to account succinctly for differences among these films?
3. How are these film characteristics and/or factors related to viewer learning and to expert judgments of instructional film effectiveness?

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CHAPTER X

METHODOLOGICAL PERSPECTIVE

Film Production Characteristics

Study Two was planned as a factor analysis. The films, originally produced by Tendam (1961), and the accompanying printed scripts were reviewed intensively to locate those film production variables which appeared to vary among the films in the series and which could be quantified satisfactorily and meaningfully as individual differences among the films. All possible variables were considered. Only those which provided negligible variance among the films, which were not amenable to absolute objective measurement, or which were essentially unquantifiable within the limits of this study were discarded. Three individuals participated in the analysis of the films for the purpose of quantifying the pertinent variables. Some characteristics could be measured during ordinary projections of the films, others were developed from the printed scripts, and still others required a frame by frame analysis using a movie viewer with hand-operated film advancing apparatus. In those few instances where some uncertainty arose as to the correct measurement to be recorded, two film analysts made independent decisions, compared their results, and referred back to the film in question to resolve remaining differences. No inter-analyst reliability estimates were deemed necessary. Every attempt was made to minimize errors in observing and recording measurements short of complete independent replication of the film analysis.

A total of 26 film variables were selected for inclusion in the study and are listed below, together with a) the methods or formulae used to produce the scores, and b) verbal definitions and discussions where necessary. For purposes of notation, the variables have been assigned consecutive numbers and one of four category designations: temporal characteristics (T), audio characteristics (A), visual characteristics (V), and audio-visual interaction characteristics (AV).

Film length (T1)

a) Time in minutes.

b) The length of the total film in minutes of running time as published by Tendam (1961).

Formula and computation scene length (T2)

a) Time in minutes and decimal fractions determined by stopwatch during screening.

b) The summed length of scenes showing formulae, derivations, computations, and data recording in terms of minutes of running time.

Commentary rate (T3)

a) Total words in commentary/T1.[9]

b) The average number of words per minute in the commentary or audio portion of the film. Words were defined as individually spoken words, numbers, and formulae.

Flesch reading ease index (A4)

a) 206.835 - .846 (syllables per 100 words) - 1.015 (words per sentence).

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[9] The symbol "/" is used in this listing to mean "divided by."

b) The standard Flesch readability formula applied to the commentary as represented by the printed scripts.

Flesch human interest index (A5)

a) 3.635 (proportion of personal words to total words) + .314 (proportion of personal sentences to total sentences).

b) The standard Flesch human interest formula applied to the commentary. Personal words were defined as personal pronouns and proper names. Personal sentences were defined as questions, commands, requests, and quotes.

Repeated statements (A6)

a) Films including repeated statements (code 2) vs. films not including repeated statements (code 1).

b) This variable was treated as a true dichotomy. Statements were defined as "...any sentence or clause which states an item of information" (O'Connor, 1950, p. 272).

Affixes (A7)

a) Number of affixes/total words.

b) Defined as letters or sequences of letters occurring as a bound form attached to a word or inserted within a word to produce a derivative word (e.g., un in untie, s in weights).

Nouns with a concrete referent (A8)

a) Number of nouns with a concrete referent/total nouns.

b) Defined as all nouns with referents that can be photographed or sound recorded.

Verb-category words with active meaning in context (A9)

a) Number of verb-category words active in context/total verb-category words.

b) "Includes all verbs, gerunds, and participles used in active context. Action was defined as some motion which could be portrayed by motion pictures. 'Drifting' in 'drifting clouds'...is active, but 'spanning' in 'a wooden bridge spanning a frozen stream' would not be called active" (O'Connor, 1950, p. 274).

Verbs with active meaning out of context (A10)

a) Number of verbs with active meaning out of context/total verbs.

b) Defined as all verbs for which the first dictionary definition has active meaning. "For example: While the verb 'cast' in 'the mountain casts a four o'clock shadow' does not denote action in context, the definition of the verb out of context (the dictionary definition) does indicate action" (O'Connor, 1950, p. 274).

Color (V11)

a) Color (code 2) vs. black and white (code 1).

b) Treated as a true dichotomy.

Cuts (V12)

a) Number of cuts appearing in film.

b) Defined as "The instantaneous change from one scene to another. Successive frames contain the last frame of one scene and the first frame of the following scene" (UFPA

Nomenclature Committee, 1960, p. 10).

Dissolves (V13)

a) Number of dissolves and fades appearing in film.

b) Defined as "A shot-linking effect which results when one scene fades out at the same time that a second scene fades in" (UFPA Nomenclature Committee, 1960, p. 11). Fades to or from a blank screen were also included in this variable.

Abrupt camera position changes (V14)

a) Number of abrupt changes in camera position/total scenes.

b) Defined as instantaneous shifts in the angle at which the camera photographed the action and in the "distance" of the camera from the action (accomplished either by camera moves or by lens changes). Such changes occur only at the point of a cut. Scenes are defined here as numbered in the printed script. As such, there may be cuts and abrupt changes in camera position within a single scene.

Gradual camera position changes (V15)

a) Number of gradual changes in camera position appearing in film.

b) Defined as V14 but occurring gradually within a shot or scene rather than between a shot or scene (at a cut). Pans, zooms, dolly shots, etc., are examples of such changes (see UFPA Nomenclature Committee, 1960).

Human appearances (V16)

a) Number of human appearances in film.

b) A human appearance was counted for every scene in which a human being or part thereof appeared on the screen. The total number of scenes showing humans was counted as the index of human appearances for each film.

Repeated scenes (V17)

a) Films including repeated scenes (code 2) vs. films not including repeated scenes (code 1).

b) This variable was treated as a true dichotomy.

Scenes reproducing a visual experience (V18)

a) Number of scenes reproducing a visual experience/total scenes.

b) Defined as "Scenes [that] represent what the human eye would see when presented with the original situation" (O'Connor, 1950, p. 272).

Scenes contriving a visual experience (V19)

a) Films including scenes which contrive a visual experience (code 2) vs. films not including such scenes (code 1).

b) This variable was treated as a true dichotomy. Contrived visual experiences were defined as those which "...contrive for the unaided eyes a sense experience not normally perceptible" (O'Connor, 1950, p. 272). Time-lapse, slow and stop-motion photography, split-screen, animation, microphotography, and use of working models are all examples of contrived visual experiences.

Formula and computation scenes (V20)

a) Number of scenes including formulae and computations/total scenes.

b) Defined as scenes in which formulae were presented, derived, or used to compute solutions using experimental data from the physics experiments depicted on the screen. Charts and graphs, if they involved formulae and computations, were counted also. This variable is similar to O'Connor's "scenes symbolizing a visual experience" but is more specific to the films used here.

Demonstrated statements (AV21)

a) Number of demonstrated statements/total statements.

b) Defined as statements in the commentary which are accompanied by scenes demonstrating or reproducing the information presented in the statement.

Unillustrated nouns with concrete referents (AV22)

a) Number of unillustrated nouns with concrete referents/total nouns with concrete referents.

b) Defined as concrete referent nouns in the commentary for which the referent is not presented in the accompanying scene.

Unillustrated verb-category words with active meaning in context (AV23)

a) Number of unillustrated verb-category words active in context/total verb-category words active in context.

b) Defined as active in context verb-category words for which the action is not presented in the accompanying scene.

Ratio of words to scenes (AV24)

a) Total number of words in commentary/total scenes.

b) This ratio may be viewed as average amount of commentary per scene or scene length in words.

Ratio of personal words to human appearances (AV25)

a) Number of personal words in commentary/number of scenes in which humans appear.

b) This ratio may be viewed as a measure of the relative personal emphasis of the audio and video components of the film.

Ratio of personal sentences to human appearances (AV26)

a) Number of personal sentences in commentary/number of scenes in which humans appear.

b) Same as AV25. The two measures need not be comparable since personal words and sentences are defined differently (see A5).

Criteria and Reference Variables

Two major criterion measures of relative film effectiveness were originally planned for development and use, one to be based on measured student achievement in relation to each filmed demonstration, the other to be based on expert judgments of instructional film effectiveness. Each of these developments resulted in the establishment of two separate measures. Thus, four dependent variables were used in the statistical analysis. In addition, four reference variables were included to aid in determining the effects of order of film presentation through the semester physics course and to aid in relating some of the findings of Study One to specific film production characteristics.

Student Performance Criteria. From the Tendam study (1961), the mean difference between film and live group quiz performance was determined for each filmed demonstration in each year of the study, 1960 and 1961. While the quizzes from which these mean difference scores arose differed in both content and difficulty, it was felt that relative differences in film vs. live presentation effectiveness were adequately reflected by these scores. The differences between means were computed so that the larger the difference between film and live group means favoring filmed presentation, the higher the score assigned to that particular film. Conversely, the scores of films which had been found inferior to their counterpart live presentations decreased as an inverse function of the mean differences. A constant was then added to the difference scores for each film to remove negative values.

The difference scores resulting from the two years of the Tendam study were found not to be comparable. Their correlation was computed as -.14. With 12 degrees of freedom, this value does not differ significantly from zero.[10] Because of this disparity, the measures for the two years were maintained as separate variables. Difference scores are generally recognized as unreliable estimates. Further, this comparison was made over two years with different subjects participating in each year. Minor changes in one of the films between the two years could also have contributed to the unreliability noted here. However unreliable, the two measures do represent indices of student performance (which may also be unreliable between two occasions). In discussions to follow, the student achievement criteria for 1960 and 1961 are referred to as SA-60 and SA-61, respectively.

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[10] There are 12 degrees of freedom in this correlation because there are 14 filmed demonstrations. There are 19 films however, some having been combined into the same demonstration. Since all other analyses were based on films, not demonstrations, the same difference score was assigned to films incorporated in the same demonstration. This procedure was also applied to the reference variables.

Expert Judgment Criteria. Six experts, divided into two groups of three to represent subject-matter specialists (in this case, physics) and film specialists, were retained as judges. The physics specialists were instructors at Purdue University, all of whom had taught subsections of the introductory physics course in which the films were designed to be used. The film specialists were staff members of Purdue's TV unit and Film Library, all of whom had had extensive experience in the production and use of instructional films. None of the judges had been involved in the production of the particular physics demonstration films under study or in the previous research using them.

In two sessions, all 19 films were viewed by all judges. Films were divided randomly between the sessions, which were held two days apart, and were further randomly ordered for presentation. Each judge rated every film immediately after its screening using an instructional film rating form adapted for use in this investigation from a form constructed by Greenhill (1955). The adapted rating form may be found in Appendix D. Included in the instructions given to the judges was a statement concerning the purpose and target audience for which the films were produced. The rating for each film from each judge was the sum total of the ratings given on the 15 six-point scales included in the form. By summing these totals over the three film specialists and the three physics specialists separately, two measures of judged effectiveness were obtained for each film. The measures based on judgments of physics and film specialists have been designated EJ-P and EJ-F, respectively.

Two preliminary analyses of the obtained ratings were undertaken. First, an attempt was made to determine the effects on the ratings of fatigue within the judging sessions and systematic variations between the sessions. The film which had been assigned randomly to the first screening position of the first session was repeated in the sixth or middle position and again in the eleventh or last position in that session. Also, the film which had been assigned randomly to the last screening position of the first session was repeated as the last film in the second session. The ratings assigned to these film showings by each specialist group were compared using analysis of variance. Summaries of these analyses appear in Table 73, Appendix D. No significant differences were noted between the specialist groups or between repeated showings of the films and no significant interactions were observed. Thus, it seems unlikely that fatigue or differences between session days affected the ratings established for the films. Second, inter-rater reliability for EJ-P and EJ-F was determined by analysis of variance. Summaries of these analyses may be found in Table 74, Appendix D. Reliability of the average ratings for EJ-F was found to be .78. For EJ-P, this value was computed as .63. These correlations are indicative of fairly adequate reliability but, especially with respect to EJ-P, agreement among judges cannot be considered perfect or even extremely high. That agreement among judges seems to be substantially higher for EJ-F than for EJ-P is a point worth noting. Further discussion of this finding will be offered later in this paper.

Order of Presentation. The order in which the filmed demonstrations had been presented in class through the semester was included in the matrix as a reference variable. Conceivably, measured film effectiveness might be systematically related to order of presentation, regardless of film production variables. It was also considered possible that some production variables might be correlated with order since the films were produced in approximately the same order as they were shown. Between the 1960 and 1961 portions of the Tendam study, one film was displaced in order. This was not considered consequential, however, so only the 1961 order of presentation was used as a variable. It was designated as OP-61.

Indices of Study One Results. Three reference variables were developed to represent results obtained in Study One for the three past experience variables (see Chapter VI). The first of these was constructed from the observed main effect favoring the conventional, live presentations over the filmed presentations when only the last four demonstrations were considered. This effect was found using the past experience with instructional film variable and is summarized, symbolically, in Table 24, Chapter VIII. The films were dichotomized into those films for which this effect was not found (code 2) and those for which the effect was found (code 1). Thus, films associated with quizzes #11 through #14, on which the live group students had scored higher than the film group students, were assigned a score of 1 while films associated with quizzes #1 through #10 were assigned a score of 2. This variable was added to the matrix as PXIF'. The second variable, designated PUFL', was constructed to represent the finding that film group students who had used the Purdue Film Library obtained higher scores on quizzes #6 through #10 and #11 through #14 than did live group-film library users (see Table 24, Chapter VIII). Accordingly, the films were divided into those associated with quizzes #6 through #14 (code 2) and those associated with quizzes #1 through #5 (code 1). The third of these reference variables was developed in a manner similar to PXIF' and PUFL' and has been referred to as PXEF'. It indicated the significantly higher scores obtained on quizzes #6 through #10 by film group students having extensive past experience with entertainment films.

Description of the Films

The films used in both Study One and the present investigation have been listed by title elsewhere (Tendam, 1961; Tendam and McLeod, 1962) so they need not be specifically identified again. Of the 20 films produced by Tendam, 19 were studied here. One film had been dropped from the 1961 portion of the Tendam study making complete data unavailable for it. While the whole of Study Two, in one sense, is devoted to a detailed description of these films, some additional descriptive information may be appropriately included in this section.

All of the films were produced by the Purdue Motion Picture Production Unit. A relatively straight-forward expository presentation technique was employed. While no dramatic format or other similar embellishments were used, some attention-gaining and emphatic devices were included. The producers attempted to construct the films to be as similar to conventional classroom demonstrations as possible while still utilizing the unique advantages offered by film.

The films were designed to be generally independent of one another but some common elements did exist. The same commentator was used throughout the series and represented a "detached voice." When a human being appeared on the screen, it was always one of two individuals, neither of which talked on film. One of these persons was the regular classroom lecturer. On some occasions, the same apparatus was used for more than one physics demonstration and thus appeared in more than one film. Consequently, this film series is probably more homogeneous with respect to production variables than that used by O'Connor.

CHAPTER XI

FILM PRODUCTION FACTORS

Correlational and Factor Analyses

The final collection of measures included 34 variables. The matrix of intercorrelations among these variables was computed using Pearson product-moment procedures and is presented in Table 70. Seven measures (four film production characteristics and three reference variables) had been constructed as true dichotomies and are so indicated in Table 70, together with the proportional balance of the split obtained for each. Correlations among these variables are therefore phi coefficients while correlations between them and other continuous variables are point-biserial coefficients. Correction of these correlations for the attenuating effects of differing proportional splits was not undertaken. All other coefficients are, of course, Pearson correlations.

Factorization of the matrix was accomplished using a principal-factor solution, communalities for each variable being estimated by the highest correlation in the row associated with that variable. The unrotated factor matrix emerging from this procedure may be found in Table 75, Appendix D. An examination of the latent roots obtained from the factorization process indicated that six factors, accounting for virtually 100% of the variance, might be selected for rotation. The Carroll biquartimin oblique rotation was applied to this six factor

Table 70

Matrix of Intercorrelations, Means (x), and Standard Deviations (σ) for Thirty-Four Film Variables

Variable	T1	T2	T3	A4	A5	A6	A7	A8	A9	A10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	AV21	AV22	AV23	AV24	AV25	AV26	SA-60	SA-61	EJ-P	EJ-F	OP-61	PXIF'	PUFL'	PXEF'	$\bar{X}$	σ
T1	-	21	12	-49*	-43	-03	-25	-20	-36	-23	45	65*	54*	07	22	35	31	-50*	18	66*	07	23	-05	11	54*	02	09	04	-30	-72*	34	-37	32	-02	10.26	6.23
T2		-	14	-11	-40	-20	-10	01	-42	25	13	-17	31	-29	-02	05	-26	-26	-27	48*	-30	16	28	72*	-02	01	30	-21	06	-60*	23	-14	10	-02	56.37	44.34
T3			-	40	-60*	-20	-56*	-11	-15	05	-03	15	-10	30	15	-12	-50*	-30	-40	25	-08	-01	-02	27	20	26	13	-17	-36	-18	-21	02	-09	-08	104.68	19.39
A4				-	-11	00	-14	28	22	33	-25	-27	-67*	-31	04	-45	-28	-10	-28	-21	-14	13	28	20	-07	31	-05	-13	10	37	-37	32	-35	-06	53.52	8.83
A5					-	43	32	27	14	01	-27	-30	-21	-12	-31	-10	36	35	37	-56*	41	-44	-37	-21	-17	06	10	39	25	39	-14	30	-01	26	8.74	4.25
A6						-	-12	-04	-36	02	04	04	05	00	14	08	63*	33	15	-32	42	16	-12	-11	-20	02	-13	09	19	00	08	-19	-04	-21	Dichot.	1/4-3/4
A7							-	23	42	07	-21	-29	-03	-19	-24	-05	29	22	37	-28	06	03	18	-03	-24	-26	-18	08	26	19	20	11	38	47*	26.46	7.88
A8								-	-01	44	-44	-48*	-21	-57*	-59*	-19	-02	-12	11	-35	00	-01	22	11	-18	26	13	14	-21	04	-46*	36	-43	-10	56.26	11.95
A9									-	-46*	-16	-06	-18	00	-11	15	-02	15	16	-35	18	-37	-34	-24	-27	-27	-24	-12	09	67*	15	-10	16	08	44.42	8.93
A10										-	-48*	-44	-13	-43	-21	-30	-11	-04	07	-05	-34	27	60*	16	-11	21	03	02	10	-24	-23	41	-20	17	31.47	13.05
V11											-	36	02	07	46*	-16	-07	-34	-07	57*	-11	46*	05	-07	53*	-12	-06	-06	30	-20	31	-29	36	10	Dichot.	1/3-2/3
V12												-	08	56*	72*	54*	26	-15	-01	48*	07	08	-17	-25	24	-21	-14	-09	-30	-40	32	-32	26	-04	25.58	14.06
V13													-	-08	-15	50*	29	-05	18	12	27	-11	-24	13	-07	-07	20	-20	-10	-35	44	-56*	26	-26	9.84	6.93
V14														-	38	31	-03	26	-10	13	09	-19	-34	-34	00	-30	-28	13	-32	-05	08	-13	15	03	16.53	8.98
V15															-	26	-02	-02	-25	39	-08	29	13	-19	03	-20	-14	-36	16	-17	34	-25	25	03	2.05	2.37
V16																-	42	13	26	05	27	-18	-33	-21	-46*	-44	-24	-22	-20	-25	59*	-66*	25	-35	11.00	7.97
V17																	-	16	58*	-21	42	13	-14	-16	-10	-10	-25	26	13	-12	41	-39	29	-07	Dichot.	1/2-1/2
V18																		-	-05	-63*	-16	-20	-06	-39	-65*	-45	-24	-05	-03	35	-18	17	-27	-11	61.68	16.97
V19																			-	-06	40	-03	-21	-30	09	-10	-42	54*	27	00	46*	-15	51*	37	Dichot.	1/2-1/2
V20																				-	-20	36	21	30	61*	-13	-01	-10	-15	-71*	37	-16	36	22	25.21	17.48
AV21																					-	-43	-67*	02	00	23	07	22	02	20	30	-32	25	-04	89.37	10.00
AV22																						-	80*	-04	17	-20	-33	-26	22	-35	20	-25	13	-10	15.68	10.21
AV23																							-	15	02	-10	-09	-32	12	-28	-10	15	-10	04	14.74	12.18
AV24																								-	20	37	54*	-09	-06	-36	00	05	04	08	51.11	25.32
AV25																									-	40	28	34	-07	-31	-05	18	22	38	1.79	1.45
AV26																										-	58*	40	11	12	-44	30	-26	01	.66	1.02
SA-60																											-	-14	-14	-14	-29	16	-16	-01	21.52	4.77
SA-61																												-	10	08	-20	38	02	36	18.36	5.05
EJ-P																													-	35	36	-15	45	31	219.42	17.20
EJ-F																														-	-28	18	-22	-05	208.26	18.22
OP-61																															-	-77*	81*	11	7.47	3.91
PXIF'																																-	-46*	46*	Dichot.	1/4-3/4
PUFL'																																	-	58*	Dichot.	1/3-2/3
PXEF'																																		-	Dichot.	1/3-2/3

* = Significant at .05 level.

Where:

T1	Film length
T2	Formula and computation scene length
T3	Commentary rate
A4	Flesch reading ease index
A5	Flesch human interest index
A6	Repeated statements
A7	Affixes
A8	Nouns with a concrete referent
A9	Verb-category words with active meaning in context
A10	Verbs with active meaning out of context
V11	Color
V12	Cuts
V13	Dissolves
V14	Abrupt camera position changes
V15	Gradual camera position changes
V16	Human appearances
V17	Repeated scenes
V18	Scenes reproducing a visual experience
V19	Scenes contriving a visual experience
V20	Formula and computation scenes
AV21	Demonstrated statements
AV22	Unillustrated nouns with concrete referents
AV23	Unillustrated verb-category words with active meaning in context
AV24	Ratio of words to scenes
AV25	Ratio of personal words to human appearances
AV26	Ratio of personal sentences to human appearances
SA-60	Student achievement criterion from 1960 Tendam data
SA-61	Student achievement criterion from 1961 Tendam data
EJ-P	Expert judgment criterion from physics specialists
EJ-F	Expert judgment criterion from film specialists
OP-61	Order of presentation in 1961 Tendam study
PXIF'	Study one result - inferiority of film group to live group on quizzes #11-#14
PUFL'	Study one result - superiority of film-instructional film experience group to live counterpart group on quizzes #6-#10, #11-#14
PXEF'	Study one result - superiority of film-entertainment film experience group to live counterpart group on quizzes #6-#10

matrix. Rotated factor loadings for all 34 variables on these six factors are shown in Table 71 and the correlations obtained between these factors appear in Table 72. Table 76, Appendix D, contains the transformation matrix chosen by the rotation program. As an aid to interpretation, a cut-off point was chosen to determine the meaningfulness of factor loadings. The .05 critical value for an r with 17 degrees of freedom defined this point at .456. Factor loadings considered interpretable on the basis of this criterion have been underlined in Table 71.

An inspection of the correlations and factor loadings for the dichotomous variables gives little reason to suspect that these variables introduced "difficulty factors" into the analysis. Factors IV and VI were found to contain three and two dichotomous variables, respectively, but the proportional splits being correlated were dissimilar in each case.

Discussion

Factor Interpretation. Of the six factors isolated by the analysis, all but Factor VI appear to be relatively complex common factors containing from five to seven variables. In the following discussion of these results, an attempt has been made to attach descriptive names to the factors identified; however, at the present stage of research in film production variables and with the lack of previous analyses with which to compare results, these factors and factor names should be considered extremely tentative. The usefulness of factor analysis as applied here lies primarily in its ability to generate plausible hypotheses which may be worth more detailed investigation. Consequently,

Table 71

Rotated Factor Loadings for Six Factors

Variable	Factors					
	I	II	III	IV	V	VI
V12	-.71	.14	.24	-.26	-.01	.14
V14	-.68	-.10	.01	-.26	-.22	.01
V15	-.67	-.04	.06	-.08	.26	-.07
A8	.59	-.12	-.11	-.06	.08	.18
AV24	.56	.27	.25	-.01	-.02	-.34
A10	.48	.15	-.02	.03	.52	.18
V11	-.45	.01	.43	.16	.20	-.05
SA-60	.41	.10	.25	-.25	-.27	-.22
V13	.27	.80	-.06	-.03	-.19	.07
V16	-.16	.67	-.36	-.08	-.18	.11
A4	.07	-.52	-.12	-.09	.17	-.24
T2	.45	.47	.07	.03	.28	-.31
T1	-.18	.46	.53	-.14	.07	.22
OP-61	-.12	.68	-.01	.54	.02	-.05
PXIF'	.14	-.73	.23	-.10	.03	.02
EJ-F	-.06	-.44	-.36	.18	-.39	-.19
AV25	-.18	-.22	.88	-.04	-.02	.01
V18	-.11	-.13	-.63	-.09	.01	.21
V20	-.26	.20	.57	.03	.27	-.20
AV26	.33	-.24	.47	-.22	-.22	.04
SA-61	.02	-.30	.49	.11	-.24	.40
PXEF'	-.02	-.26	.48	.59	-.04	-.08
A7	.27	.06	-.17	.67	.02	.00
V19	.08	.18	.20	.54	-.12	.43
PUFL'	-.15	.39	.31	.73	-.07	-.12
EJ-P	.07	-.05	.03	.61	.14	-.01
T3	-.18	-.14	.16	-.45	-.05	-.37
AV23	.15	-.16	.08	.11	.88	.02
AV22	-.15	-.03	.06	.14	.87	.21
AV21	.06	.29	.12	.08	-.61	.21
A9	-.10	.06	-.36	.39	-.47	-.44
A6	-.06	.06	-.09	-.14	.13	.67
V17	.01	.35	-.01	.19	.02	.67
A5	.20	-.18	-.04	.24	-.32	.40

Table 72

Correlations Between Six Factors

	Factor					
	I	II	III	IV	V	VI
I	-	-.31	.07	-.14	.01	.01
II		-	.20	-.10	.15	-.06
III			-	-.17	.16	-.19
IV				-	-.12	.21
V					-	-.30
VI						-

emphasis in this discussion has been placed on the construction of hypotheses, rather than on the premature construction of conclusions.

Factor I is composed of five variables loading meaningfully on this factor only and one variable whose relation to this factor is roughly equal to its loading on another factor. Dominant among these variables are cuts and abrupt and gradual changes in camera position, all with high negative loadings. This cluster suggests a visual dimension which may be related to continuity of perceptual experience in viewing films. Cuts and changes in camera position require shifts of fixation and attention on the part of the viewer. Thus, films with fewer such changes may be perceptually less complex. Three predominantly audio characteristics load positively on this factor. These are: nouns with concrete referents, verbs with active meaning out of context, and ratio of words to scenes. Films with large word to scene ratios and with many concrete referent nouns and action verbs would seem also to require more changes of auditory attention and fixation. Complexity in the audio portions of films may thus be implied here. This sense of "complexity" need not involve difficulty of the words used or the rapidity with which these words are presented. Neither Flesch readability or commentary rate are loaded on this factor. Rather, the amount of audio or video manipulation used is the essential aspect of complexity on which this factor rests. Given an intricate concept to be demonstrated or communicated, the film may utilize cuts to close-up shots, taken from different points of view, together with zooms, pans, etc., and/or it may concentrate detailed verbal description, with many references to concrete objects and actions, in the commentary associated with a single, unchanging scene. The bipolarity suggested by the positive and negative loadings of the audio and visual variables, respectively, may represent audio vs. video emphasis in production. It may be that, for some content (possibly that which is less amenable to verbalization), more visual description is required, while for other content (possibly that which is more readily verbalized), more reliance is placed on verbal description. Thus arising from this discussion, one suggested identification for Factor I is Audio-Visual Complexity.

Some other variables are of interest in connection with Factor I, although their loadings are marginal. It seems apparent that films with more cuts and camera changes are also those more likely to be photographed in color. Also, films scoring toward the audio pole of this dimension tended to devote more screen time to the presentation of formulae and computations. These relationships add other implications to the audio vs. video emphasis hypothesis. It is likely that producer decisions regarding each film variable are seldom made independently. One major decision may affect, consciously or unconsciously, the utilization of whole networks of film characteristics. Color, for example, may be used because of a general emphasis on visual communication in a given film, rather than because of an independent estimate of its contribution to instruction. Further, student achievement in 1960 was related positively, though marginally, to Factor I. Perusal of the intercorrelations in Table 70 indicates that SA-60 correlates .54 with ratio of words to scenes. Thus, in the 1960 Tendam study at least, films employing more commentary per scene were likely to result in larger mean differences in achievement for film group students as compared to live group students. The meaning of such findings is difficult to comprehend because the live instructional presentations have not been subjected to the same elemental analysis as applied here to the film presentations. But it is possible to hypothesize that learning is facilitated if the complexity of the material is centered in the audio rather than the video component. Alternatively, verbalizable material may be more readily learned than nonverbalizable material. Related to this, it is interesting to speculate on the findings to be expected where there is nonverbal measurement of learning outcomes.

Factor II correlates -.31 with Factor I and may, therefore, be related to some extent to film complexity. On the surface, this factor appears to be a conglomerate of rationally unrelated variables. Considering its positive loadings for dissolves, film length, and formulae and computation scene length however, a time dimension is suggested. Fades and dissolves, in film grammar, often denote the passage of time. They may be viewed as roughly equivalent to chapter changes as opposed to cuts which may represent sentence or paragraph endings. The loadings for human appearances and Flesch reading ease (negatively loaded) are not irreconcilable to this interpretation since, like dissolves, they may contribute to perceived film length. However, a deficiency exists in the human appearances measurement since it was not corrected for differences in film length as were other, similarly measured variables. Its loading on Factor II may simply be an artifact. While cuts and dissolves were also left uncorrected, their variance is much less dependent on length differences among films. Regardless of the possible artifactuality of human appearances, one possible name for this factor is Temporality, implying both a physical and a psychological time dimension.

Order of presentation and PXIF', the film vs. live main effect on demonstrations #11 through #14 from Study One, were found to be related to Factor II. These findings indicate that the films appearing later in the series tended to be inferior instructionally to their live presentation counterparts and were characterized by more dissolves and human appearances, greater length, and somewhat more difficult commentary. Hypotheses regarding the effects of temporal characteristics of films on learning seem warranted from these results, although here again a comparison between film and live presentation temporality might be enlightening. The student achievement criteria do not involve this factor substantially. The film specialists' judgments of film effectiveness seem to have been affected negatively by film temporality. That is, they generally gave poorer ratings to the longer films. Since the physics specialists apparently did not respond significantly to this factor, some important differences among groups of raters may be suggested. Further discussion of this possibility is included later in this report.

Factor III must be defined mainly in terms of three variables; ratio of personal words to human appearances, scenes reproducing a visual experience, and scenes showing formulae and computations. Ratio of personal sentences to human appearances also loads positively here, as does film length. The name Video Iconicity may be tentatively advanced for this factor. The ratios of personal words and sentences to human scenes indicate disparity between personal reference in the commentary and personal representation on the screen. Seemingly, iconicity, which may alternatively be viewed as degree of realism or concreteness, would require at least as much personal reference in the film as in the commentary. In films where the speaker is a "detached voice" rather than the individual shown on the screen, more human appearances should provide more correspondence with reality for the viewer. The loading for the human appearance variable, while not interpretable in itself, at least supports this interpretation. The amount of the film devoted to reproducing visual experiences, that is, experiences observable by the unaided eye, should also be an essential component of realism. This variable is, of course, negatively related to scenes showing formulae and computations, which are symbolic representations of experiences. It is surprising to note that color is marginally related to this dimension inversely. Apparently, color was not positively associated with realism in these films. It should also be noted that lack of realism is more evident in the longer films.

While it might seem at first that this factor has as much in common with O'Connor's (1950) concept of salience as with iconicity because of its personal referent aspect, the salience dimension was disregarded here. If salience was represented, the Flesch human interest variable should be expected to participate. Further, there is as yet little evidence for either the orthogonality or the unidimensionality of iconicity and salience, as O'Connor defined them. The two characteristics may be correlated and may appear in the same factor(s).

On the basis of the positive loadings of SA-61 and PXEF' on Factor

III, some hypotheses worthy of further consideration may be formulated. Student achievement, as measured in the 1961 portion of the Tendam study, is apparently related inversely to the degree of visual realism in the films. A negative relationship exists also between realism and the superiority of film group subjects with extensive entertainment film experience over their live group student counterparts. Considering some of the differences between film and live presentations, one meaning of this finding is obtained. The live presentation is completely realistic; it is, in fact, the criterion against which film realism is validated. There is a human constantly before the viewer. The factor loadings suggest that, to the extent that the film closely approximates the real, live situation, the two conditions will not produce different amounts of learning. The closest possible approximation would be obtained with filmed recordings of live presentations and comparisons between these two conditions would, according to these data, be least likely to result in observed differences in learning outcomes. To the extent that the film deviates from the live situation (by including fewer human scenes, fewer reproduced scenes, and more formalized formula presentation), differences in learning are more likely to appear and may favor the film presentation conditions. This prediction may hold particularly for viewers with entertainment film experience, although it is difficult to explain why this should not also be the case for individuals with instructional film experience. The latter variable does load positively on Factor III but this loading is too low (.31) for meaningful interpretation.

Factor IV can be given a fairly clear identification on the basis of its two film production variables, affixes and scenes contriving a visual experience. Both of these variables involve the construction or alteration of audio or visual experiences from existing experience, i.e., both are artifices built from more basic, real, or usual experience. Affixes are words contrived from root words by the addition of prefixes, suffixes, etc. Contrived scenes are those which present unusual or illusory experiences through filmic modification of otherwise simple photographic recording. Slow motion, split screens, and microphotography are all examples of contrivances from unaided visual experience. Thus, Factor IV may be called Artificiality. Artificiality appears to be uncorrelated with Video Iconicity. Obviously, the content of a scene may be realistic and yet be artificially altered for presentation, for example by the use of slow motion.

PXEF' and PUFL' both load highly on Artificiality. Apparently, among students having past experience with entertainment and/or instructional films, those assigned to the film group learned significantly more than those assigned to the live group on some demonstrations, particularly those where the film condition was partly composed of contrived words and scenes. It is not known whether the film and live presentations would be found to differ in terms of the number of affixes used, but clearly the live presentation could not contain contrived scenes.[11] The implication from Study One was that past film learning experience aids film learning and that continued practice enhances this effect. Whether the phenomena represented by PXEF' and PUFL' are caused by within-course practice or the existence of special perceptual abilities is a question for further research. One is tempted to suggest from these results, however, that film literacy is a learning set or ability, acquired through practice in learning from films, which enables an individual to perceive and comprehend comfortably, artificial experience in film presentations.

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[11] Actually, conventional classroom presentations could include two types of nonfilmic visual contrivances, namely, working models and the effects produced by such special devices as stroboscopic light. The usefulness of these devices is restricted to only a few specific situations however.

It may also be noted that the physics specialists' ratings involved this factor predominantly. They judged films with more artificial content as more effective instructionally than other films with fewer contrived scenes and words, possibly because such contrivances were considered contributive to clear presentation of the physical principles being demonstrated. A novelty factor might also be operating here since, relative to other film sequences, artificial scenes are often especially interesting to individuals unsophisticated in the technical aspects of film production.

Factor V has been given the name Audio Iconicity. Dominant variables on this factor are: unillustrated concrete referent nouns, unillustrated verb category words with active meaning in context, and demonstrated statements. Verb category words active in context and verbs active out of context are also loaded here. Whereas Factor III, Video Iconicity, seemed to involve realism of the visual presentation, Factor V is associated with the iconic base or relevance of the commentary content. This interpretation refers not simply to the concreteness of the commentary, but rather to that portion of audio concreteness which is correlated with the visual presentation. Perhaps the name Audio-Visual Iconicity would better denote this aspect of interdependence between verbal and visual referents. While the student achievement variables apparently do not involve this factor, there is some indication that the film specialists were favorably disposed toward films with a high degree of audio iconicity.

Correlated -.30 with Factor V is Factor VI, which represents Internal Repetition in the films. As would be expected, repeated scenes and repeated statements are correlated. Thus, when a scene is repeated for emphasis or summary, accompanying statements in the commentary are also usually repeated.

Marginal loadings on this factor were obtained for some other variables of interest. Scenes contriving a visual experience are sometimes repetitions in slow or stop motion of scenes already presented. The loading of .43 on Repetition for this variable may arise from such practices. Also, student achievement in 1961 is loaded .40 on Factor VI but it was not observed to be highly correlated with either repetition variable. From Table 70 it is seen however that SA-61 and the contrived scenes variable correlate .54 while there is no significant relation between affixes and SA-61. These interrelationships lead to the hypothesis that contrived visual repetition may facilitate film learning considerably. It is also conceivable that salience is involved here since the Flesch human interest index, which is loaded .40 on Repetition, yielded correlations of .39 with SA-61 and .37 with contrived scenes. Although these implications are drawn from marginal factor loadings and correlations, they provide ample justification for the investment of further research effort.

Salience and Iconicity. Some of the intercorrelations reported here may be compared with those obtained by O'Connor (1950) and reproduced in Table 69. While some variables common to both studies yield similar intercorrelations, there are many divergent results. This finding is not unexpected since the films and subjects used in the two studies differed considerably. However, if there are underlying common factors which describe individual differences among films, then some similarity might be expected even between these isolated and non-random samples from the universe of instructional films. Admittedly, the research reported here represents one special case. It cannot prove the validity of O'Connor's two factor formulation. As a special case however, it can disprove or qualify the generality of that formulation. Such qualification appears warranted since no two clear factors identifiable as salience and iconicity were found in this investigation.

The factors defined as Audio Visual Complexity, Video Iconicity, Artificiality, and Audio Iconicity all seem to embody some aspect of iconicity, as it was conceived by O'Connor. Salience, if it exists in these results at all, is probably represented in the Artificiality and Internal Repetition factors. It seems likely that film iconicity is not unidimensional but instead is a compound divisible into more basic independent factors. While this may also be the case for the salience concept, the variables supposedly comprising it were not completely represented in this research. A more adequate analysis of its structure than was possible here would be required to judge its importance.

Expert Judgments. There is reason to believe that different classes of raters respond to different aspects of film presentations in arriving at judgments about instructional effectiveness. Film specialists were found to be affected by a wider range of film variables, representing Temporality, Video Iconicity, and Audio Iconicity factors. They generally preferred films which were shorter, more visually realistic, and which contained more audio concreteness and audio-visual iconic correspondence. The physics judges, while less in agreement with one another than the film experts, tended to concentrate their ratings primarily in the Artificiality dimension. They preferred the films on which past experience with films seemed to offer an aid to film learners; those which employed more contrived auditory and visual experiences.

Some correspondence was noticed between O'Connor's and this study's correlations of expert ratings and four variables: scenes reproducing a visual experience, Flesch human interest index (O'Connor used simply "words with a personal referent"), demonstrated statements, and ratio of words to scenes. The correlations of these variables with expert ratings are similar for O'Connor's judges and the film specialists used here. Since O'Connor implied that his judges were educators with considerable sophistication in instructional film, the results obtained in both studies, with respect to film experts at least, may be fairly generalizable. It should be noted, however, that the views of film specialists who are primarily educators may differ radically from those of individuals who are primarily artists. The orientation of the raters used in both these studies seems to be predominantly that of the educator.

The existence of systematic perceptual and preferential differences between production and subject-matter experts might have marked repercussions in both film production and film evaluation work. It would be interesting to compare learning from alternate versions of a film when each version was produced to maximize the ratings of one specific group of expert judges. The findings reported here suggest that, while both specialist groups respond to film dimensions which are relevant to learning, the film version constructed in line with physics specialists' preferences might be more effective instructionally, especially for students with extensive film learning experience.

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CHAPTER XII

CONCLUSION - STUDY TWO

Summary

Study Two was carried out as an exploration of individual differences in physical characteristics amohg a group of existing instructional films. The research aimed at determining the factors underlying individual film production variables, recognizing that the major function to be served by the study would be hypothesis generation, rather than hypothesis testing. A matrix consisting of 26 film production characteristics and 8 criterion and reference variables was constructed through extensive analysis of a series of 19 filmed demonstrations in introductory college physics. The criteria and reference variables represented comparisons of student achievement between film and live presentations of the physics demonstrational material, expert judgments of film effectiveness, order of presentation, and the value of certain past film experience variables in subsequent film learning. The matrix of intercorrelations among these 34 variables was factor analyzed and six factors were proposed to account for the variance observed in the original matrix. These factors were tentatively identified as Audio Visual Complexity, Audio Iconicity, Video Iconicity, Temporality, Artificiality, and Internal Repetition.

Hypotheses suggested by the clusters of variables identified are the following:

1. The perceptual complexity of a film is centered predominantly in the audio or video component depending upon the extent to which the concepts to be communicated are verbalizable. Verbal learning is facilitated by auditory presentation of complexity while nonverbal learning is facilitated by visual presentation of complexity.
2. There is a psychophysical time dimension, composed of variables contributing to perceptual film length as well as physical film length, underlying any film. Long films, or films perceived as long, are less effective instructionally than live presentations of the same material in the same time interval.
3. Visual realism is not necessarily desirable as a film trait. Films which deviate from exact reproductions of live presentations are more likely to result in increased learning over the conventional, live condition. Individuals having extensive past experience with films are especially suited to learning from films which lack a high degree of visual iconicity.
4. Film literacy involves the ability to interpret meaningfully contrived filmic experiences. It is a learning set or ability which is developed through film viewing practice and which facilitates learning from artificial film presentations.
5. Internal film repetition, especially repetition using artificial or contrived visual presentations, is conducive to increased learning from a film.
6. Different groups of expert judges respond to different factors in instructional films. Specialists in film production value

the succinct, concrete, or direct film presentation while subject-matter specialists value the novel, artificial, or indirect presentation.

It should be reemphasized here that the statements numbered above are hypotheses offered as possibilities for further research rather than conclusions drawn from this research.

Implications and Limitations

The major implication of this study is that an instructional film, while it is inherently an extremely complex combination of production characteristics, can be analyzed meaningfully at an elemental, physicalistic level. The "grammatical structure" of films thus revealed is relatable to overall film effectiveness and there appears to be potential advantage in determining these relationships. Whether the factors identified here for this domain will be confirmed by other analyses cannot be foretold, but it will be sufficient justification for this research if these further analyses are undertaken. Comparative effectiveness studies, either between alternative versions of the same films or between film and live presentations of the same material, should follow from analyses of this type, not precede them as they have done. It has been shown that complex film variable interactions exist and that these may be related to complex audience variable interactions. It is these system interrelationships which must be defined if film learning is to be understood and controlled. Film literacy, for instance, seems to be a relationship of this type. There may be many others.

Further support for the suggested approach arises from a consideration of some of the factors postulated in this research. Audio concreteness seems not to be related to student achievement while visual realism is apparently related to student achievement inversely. Artificiality also seems to be important. If further research establishes such findings and if similar analyses of conventional, live classroom presentations are carried out, much may be learned about the appropriate roles for film. Many instructional films and most instructional television usages seem to be active attempts to approximate the live classroom conditions but this may be exactly what is not needed. It may be that the more the visual component utilizes unreal or illusory presentation, the more it complements conventional instruction. Film has been used successfully in the presentation of real but nonverbalizable experience and in the development of affective states in viewers. Perhaps the optimal role of the visual media in instruction includes also the use of illusion to demonstrate phenomena not otherwise observable and the archetyping of abstract concepts. Knowledge of "audio-visual grammar" should enable such exploitation of the unique contributions of film and television. The values and roles of the visual media in education should not be conceived by a print-based mentality.

There are a number of limitations to this study which must be indicated so that the restrictions to be placed on generalizations from these results are clearly understood. First, the films were all physics demonstrations, produced by the same staff for the same audience. Hence, the series is far more homogeneous than any random collection of films would be expected to be. Second, only 19 films were included in the analysis. The recommended practice in factor analytic studies is to use a much larger number of individuals than this. Third, the student achievement criterion was highly unreliable in terms of comparison between the two administrations of the physics demonstrations. Fourth, the inclusion of the past experience variables from Study One was effected by the development of relatively crude measures. Personal characteristics of the audience, other than past film experience, could not be included at all. Fifth, while most of the film production variables studied were ratio scale measurements, a few had to be treated as dichotomies. The use of dichotomous variables, especially true dichotomies, with so small a sample is somewhat tenuous. Sixth, a few variables, notably human appearances, were left uncorrected for differences in film length. This oversight made the meaning of factor loadings for this variable difficult to infer. Seventh, four variables were ratios which included one component also appearing in the matrix as a separate variable. Because of this linear dependence, correlations between these ratios and their parts may be spurious. Since no factors or factor interpretations depend solely on these relationships, their inclusion seems not to have affected the analysis adversely.

The importance of these limitations is open to argument and depends in part on the uses to be made of the findings derived from the analysis. The exploratory nature of this research may indicate that the seriousness of these restrictions should be viewed as less weighty than might otherwise be the case. It is believed that the interpretations and hypotheses drawn have not taxed these data unduly. However, replications including improvements on this design are obviously required.

One more general criticism of this research might be that, by dissecting films into elemental aspects, some portion of the whole or the film gestalt is lost. A factor analytic approach, even with comprehensive coverage of individual differences and the use of second-order analysis where appropriate, may occasionally justify this criticism. On such occasions, the effects of gestalt may be determined by use of standard comparative effectiveness procedures as supplement.

DIRECTIONS FOR FURTHER RESEARCH

In one sense, the two studies making up this investigation have been combinations and extensions of previous research. They have sought to select the major variables suggested by previous findings and to apply and compare them in single, comprehensive studies. But in seeking answers to some questions, other questions are often generated. In another sense, then, they must be considered only first explorations toward a more wholistic view of learner response to instructional film.

A number of hypotheses for further research have been alluded to in the body of this report. In more general terms, these questions may be considered in four separate classes.

1. What interactions exist between the effects of the personal variables isolated in this study? Are there combinations of levels of some variables which are particularly appropriate or inappropriate for efficient learning? Do the personal prerequisites of film learning change with additional practice in learning from films? Is past experience or practice with films a substitute for previous knowledge of the subject-matter or for other personal variables?
2. Using psychophysical methodology, what are the perceptible levels of increased use of physical film variables in instructional films? Using semantic differential methodology, what is the meaning of a physical film characteristic such as

a cut or dissolve? What are the optimal roles for film in instruction? What film characteristics contribute significantly to these roles? Given specific instructional objectives for a film, can production formulae prescribing the "mix" of pertinent film variables be determined? Are these formulae generalizable to other instances of the same instructional objectives?

3. Is all formal instructional film learning dependent upon the same learner abilities and characteristics for efficient learning or are different types of films specifically associated with different audience characteristics? What relationships exist between specific film production variables and the effects of various audience characteristics on film learning? How do film utilization variables affect these relationships? Are there other learner and film variables, not included in this research, which should be studied in this connection?
4. Is it possible to select superior film learners? Can films be constructed to enhance their learning value for some individuals? Can individuals be trained to improve their learning from films? Combining the selection and training of superior film learners with more effective production and utilization of films, what maximum of instructional effectiveness can be achieved?

It is hoped that this research has provided some additional understanding of variables in the learner and in the instructional film which act to influence learning from films. It is particularly hoped that it will motivate further research efforts. The traditional instructional task has been attacked, first by the widespread use of films and, more recently, by the advent of instructional television and programed learning. These new media offer the possibility of significant advances in instructional methodology, but the accumulation of knowledge necessary for these advances will not be forthcoming from research concerned simply with gross comparisons of different methods. More basic research is needed in many areas, one of which, it is believed, concerns individual differences in learners and films.

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EXCURSUS

This essay is appended as a ballot. Its purpose is to cast one vote in support of proposals for modifying our educational research effort, as recently presented by Carpenter*, and to color this vote with experience gained in the course of the studies embodied in this research report.

If education is highly valued in the United States -- and some of us suspect strongly that it is -- then the processes of learning should deserve our closest scrutiny. If, as H. G. Wells has warned, "Human history becomes more and more a race between education and catastrophe," then the processes of learning must receive our closest scrutiny. The population explosion, the knowledge explosion, and the technological revolution place stresses on our educational system that dictate change. If these changes are to emerge as improvements, then basic understanding is needed of how, and under what conditions, human beings learn maximally.

Engineering has mathematics, physics, and chemistry to provide its base of knowledge. Agriculture has biological science, as does medicine. But education does not yet have a well-developed science of complex, meaningful, human learning. Why not?

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* See Carpenter, C. R., et al. A Research Report on Operational Plans for Developing Regional Educational Media Research Centers. University Park, Pa.: Division of Academic Research and Services, Pennsylvania State University, 1962.

Since 1954, research in education has been supported by grants from the U.S. Office of Education under the provisions of P.L. 83-531 (1954) and P.L. 85-864 (1958). These activities have served greatly to encourage interest and effort in educational research. Reports of projects so supported are beginning to accumulate and, after early failures, successes are increasingly apparent. But considered against the gravity and urgency of the problems to be solved, progress has been slow. In seeking to enlarge the area of our knowledge, perhaps our most prominent achievement has been to increase the circumference of our ignorance.

Carpenter proposes program research, not to supplant but to augment, project research. Project research is typically a "shot-gun", a "blitzkrieg" approach. It is diminutive and ephemeral, exploratory and/or applied in nature, and it often lacks antecedents from previous research or precedents for future research. It appears, in fact, that all research projects are pilot studies, in substance if not in name. While it cannot be argued that pilot studies are unnecessary, it also cannot be argued that pilot studies are sufficient. For the hypotheses and conclusions arising from exploration and application, there must be comprehensive, longitudinal, and generalizable definition, interrelation, and replication. This has not been forthcoming, and will not be, under the present system of support. Continuing research programs seem definitely to be needed.

The project reported here was carried out with a "small grant" from the Educational Media Branch, USOE. Its federal funding amounted to $2500, of which some small portion has been returned unused. Without regard to the present or future value of its findings, the fact remains that it could not have been undertaken except as a tangent to an earlier project, at least not for $2500. It may safely be estimated that $50,000 would have been required to execute the study independently of other research, and this only with the films already in hand. Further, this investigation suggests a number of other studies. These cannot be undertaken at present because funds and staff time are lacking. Thus, one investigation bred a second, more detailed study which in turn has suggested lines for additional research. None of these extensions could have been predicted beforehand. At another time, an experimenter may follow up hypotheses offered here -- at much duplication of effort and cost.

Hypotheses arising from federally supported research in nuclear physics or mental health could be, and would be, pursued as a matter of course. It is hard to believe that we value these activities more highly than education, especially since the latter is prerequisite to advancement in the former.

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APPENDIX A

REVIEW OF THE LITERATURE

In recent years, there have been a number of reviews and summaries of the instructional film research literature. Two of these (Hoban and Van Ormer, 1950; Allen, 1960) have addressed themselves to the specific area of empirical findings on audience characteristics in relation to learning from films. The former is by far the most comprehensive and important for the purposes of this research and, therefore, will be relied upon heavily for evidence reported prior to 1950. The latter, while extensive, is not detailed and will thus not be relied upon for research appearing since 1950. In any case, original references will always be cited.

Previous research studies concerning audience characteristics in relation to learning from films differ from one another in three respects. These differences among past studies affect the approach each has taken to the study of audience characteristics and, therefore, affect this summary of their findings. First, findings from research using films in formal course instruction where subjects are graded or evaluated by their test performance would be expected to differ from those obtained in a laboratory setting or where film showings are supplemental to formal course instruction. Second, results obtained with films employing direct presentation or demonstration of material would be expected to differ from those found using films cast in a dramatic, story format. Third, studies involved primarily with attitude and opinion change differ to some extent from studies concerned with factual learning. The research contained in this report is concerned only with factual learning from films which use direct demonstrations of the material to be learned and which are presented as integral parts of a formal college course. Further, this research is concerned not only with film learning, but also with differences between film learning and conventional learning which relate to audience characteristics. Therefore, in the following brief review, primary emphasis will be placed on findings resulting from research objectives and stimulus conditions similar to those employed here. Generalizable results from other research settings will be included, however, where appropriate.

The various audience characteristics which have been hypothesized as affecting learning from instructional films may be divided into five major kinds of variables; individual predispositional factors, personality factors, social-biographical factors, intellectual and educational factors, and previous knowledge and past experience factors. These five classes, although not mutually exclusive, are best discussed separately.

Individual Predispositional Factors

It might be expected that attitudes, interests, opinions, etc., with respect to the film medium and the material presented through it should be related to learning from films. Such appears to be the case, although many of these conclusions have not been well documented with experimental evidence.

Hovland, Lumsdaine, and Sheffield (1949), on the basis of their extensive research on influencing opinions by films, hypothesized that, while an individual will readily forget learned information which is not compatible with his attitudes, he will retain information which does correspond with his attitudes even to a point where retention appears to increase over time. Hoban and Van Ormer (1950) have suggested that this process be viewed as an aspect of selective perception. To the extent that learning from films or learning a given content from films would be incompatible with an individual's attitudes, one might expect to find this effect with formal instruction as Hovland and his associates did with documentary, current events films. Another aspect of this attitude might be the credibility of the communication medium and/or the message communicated. Hovland, Janis, and Kelley (1953) found that the attitude of the audience toward the communicator affected acceptance of the message and, therefore, learning and retention of the message also. However, initial differences in acceptance of opinions presented by high and low credibility media disappeared over time. Their studies also indicated that attitudes toward the subject matter being communicated influenced both the amount and the kinds of learning and retention that occurred. Carpenter (1953, p. 46) referred to this effect as the "functional dependability" of the information presented by film. He hypothesized "...a basic and necessary attitude of viewers toward learning from films, an attitude which, it is believed, strongly influences film learning, namely, the confidence of viewers in the information presented by the film and in the 'authority' of the film."

Another hypothesis proposed by Carpenter (1953) concerns the perceived needs of the learner. He suggested that the effectiveness of an instructional film might be dependent upon the extent to which the film activated personal needs in viewers for the information presented. This possibility has been supported by more recent research. Greenhill and McNiven (1956) developed a scale to measure "perceived psychological goal distance" and, with three factual films shown to high school students, determined that learning from the films increased as a function of the perceived usefulness of the material presented.

Preference for films has also been studied as a predispositional factor. Hoban and Van Ormer (1950) have summarized the pertinent findings with respect to this "like-dislike" reaction. A study by Ash (1949) correlated interest ratings of four films with an achievement test criterion. No consistent correlation between interest and learning was found over the large number of groups of college students and Navy enlisted men used as subjects. In a few subgroups, however, correlations as large as .54 were obtained. The author points out further that some consistency in interest ratings existed among the various subgroups, regardless of the films and experimental conditions imposed. He suggested the existence of a fairly consistent attitude toward instructional films. Heidgerken (1948) found that preferences for films and opinions concerning their value as aids to learning were not correlated with film learning achievement scores among student nurses. Vandermeer (1954) added the finding that, although color films are usually preferred by learners to black and white films, this effect is not great enough to affect learning significantly.

A summary of research concerning the general appeal of the movies has also been provided by Hoban and Van Ormer (1950). They concluded that films, especially the dramatic type, should be particularly appropriate for military training since the attraction of motion pictures, as measured by frequency of entertainment film attendance, approaches a maximum up to the age of 21 (Dale, 1935; Scott, 1947; Lazarsfeld and Kendall, 1948). Other studies by Sterner (1947), Sackett (Hoban, 1942), and Beck, Kelly and Peterman (Hoban, 1946) have all offered some evidence that films do have an intrinsic appeal, and that this attraction is not limited to entertainment films but also includes classroom films. One other point concerning possible relationships between entertainment and instructional films deserves mention. Miller (1957) has indicated that the motivation to be entertained and relaxed by films may transfer from experience with entertainment films to interfere with learning from instructional films. Gibson (1947) suggested that this attitude of passive relaxation or "spectator attitude" might be reduced by showing films in semi-illuminated, rather than darkened, rooms. No conclusive evidence showing the effect of this attitude on film learning is available, however.

Personality Factors

Only a few experiments have been carried out studying personality characteristics as they may be related to factual learning from films. These studies have dealt with various isolated aspects of personality or, more generally, the social-emotional response area.

A study by Dysinger and Ruckmick (1933) was concerned with changes in the galvanic skin response and pulse rate in response to dramatic entertainment films. One of their findings may be important for factual instructional films, however. They reported that "excitability" decreased with repeated showings of the same film, a finding which has since been supported by Kleitman (1945) in a study of temperature variation after movie experience. As Hoban and Van Ormer (1950) pointed out, repetition of instructional films has been shown to increase the magnitude and reliability of informational learning from these films. Relationships between film learning and the galvanic skin response might therefore deserve investigation. Research on the measurement and analysis of physiological response to film, now under way (Case and Levonian, 1962), may provide a first exploration into this potentially fruitful area.

Carpenter (1953) has suggested that, other things being equal, the effectiveness of instructional films may be a function of the extent to which a film provides for personal involvement in the situations and material presented. Hoban and Van Ormer (1950) summarized many studies concerning audience involvement in films under sub-headings such as "identification," "participation," and "anticipation." These studies dealt, however, with the manipulation of film production and utilization variables to obtain audience involvement and, for the most part, have not investigated differences in "identification," etc., as functions of individual personality characteristics which may be related to learning. One study (Kishler, 1950) has related individual attitude toward, and identification with, the main character in a dramatic film to factual learning from that film. No significant relationships were discovered.

An experiment by Allison and Ash (1951) was directed at a more general personality trait. A different level of anxiety was induced in each of three experimental groups of college students by varying instructions about a factual film and the test which followed it. Achievement on the test in each group was found to be positively related to the level of situational anxiety produced in that group. Further, no relation was found between chronic anxiety as measured by a standard personality inventory and amount of learning in any of the groups or over the total sample of subjects. One other hypothesis, offered by Hovland, Janis, and Kelley (1953), may be added here. They indicated that feelings of social inadequacy, inhibition of aggression, and depressive tendencies (low self-esteem) appeared to be related to high persuasibility while persistent aggression toward others, social withdrawal, and acute psycho-neurotic complaints (high self-esteem) were associated with low persuasibility. This relationship was discussed with respect to opinion change only, however, and its importance to factual film learning is difficult to assess.

Social-Biographical Factors

Hovland, Lumsdaine, and Sheffield (1949) studied many social-biographical factors in their work with military personnel. They found that age, religion, Army rank and length of service, and other demographic characteristics such as marital status, region of birth, etc., showed few consistent and significant relationships with knowledge and opinion gained from film. Hoban and Van Ormer (1950) have cited some evidence to the effect that the ability to learn factual material from films increases with age up to the early 20's, is maintained until approximately 45, and then gradually declines (Jones, Conrad, and Horn, 1928). They felt, though, that this trend is probably due to increases in intelligence and accumulations of knowledge during younger age, changes in motivational factors, and gradual impairment of the senses and nervous system in older age.

Sex differences have been found to exist in terms of preferences for different kinds of filmed material which in turn resulted in different amounts of learning of that material (Wise, 1939; Brenner, Walter and Kurtz, 1949; Vandermeer, 1950).

Kishler (1950) reported differences in identification with the main character due to religious differences but, as stated in an earlier section of this paper, he found no significant relationships between these variables and factual film learning. It might be expected that social role and status differences should also be associated with identification with characters and, possibly, with film preferences. Hoban (1953a, 1953b) did, in fact, find that "role aspirations" and "role valuations" were important in individual film preferences, and that socio-economic status and military rank among servicemen were related to attitude toward films and main characters. He did not relate these variables to film learning, however.

Intellectual and Educational Factors

Evidence concerning the relationship between film learning in a given situation and measured intelligence is available from a number of studies. The findings from those studies appearing prior to 1950 have been summarized by Hoban and Van Ormer (1950).

Secor (1931) reported correlations ranging from .35 to .87 between measured intelligence and film learning among high school biology students. Correlations for the same subjects learning non-filmed material were somewhat lower, ranging from .40 to .68. A study by Wise (1939) showed that, among high school history students who had been grouped into three IQ levels, amount of gain in learning was directly related to intelligence in both film and non-film groups but that this gain was greater for the film group regardless of intelligence level. The greatest difference in learning gain between film and non-film conditions was observed in the lowest intelligence level although this gain was not sufficient to bring this group abreast of the middle intelligence, non-film group. Similar findings were also reported by Richardson and Smith (1947) with high school students divided into IQ levels and by Gibson (1947) in his study of position firing with air force subjects. Jones, Conrad, and Horn (1928) obtained correlations of .69 and .71 between total measured learning after silent films and the Army Alpha Test in a heterogeneous age group. With a subsample of subjects ranging in age from 10 to 16 years, r was found to be .64. Vernon's (1946) study of British seamen also supports the conclusion that intelligence is positively correlated with total amount learned from a film. He also reported that when percent of improvement in learning was used as a criterion, the lower two-thirds of the intelligence distribution appeared to profit more from the films. However, this effect was presumably due to a low test ceiling which prevented the more intelligent subjects from obtaining higher posttest scores. In their military studies, Hovland, Lumsdaine, and Sheffield (1949) found positive relationships between film learning and both educational level and intelligence as measured by the Army General Classification Test.

Meierhenry (1952) reported findings from a state-wide instructional film project carried out in the secondary schools of Nebraska. He concluded that rankings of students on measured intelligence are not significantly altered by differences in the amount which they learn from instructional films. In his research, the more intelligent students profited more from films than did less intelligent students in terms of actual learning as measured by gain on film tests. The fact that other investigators have found differences in improvement which favored less able students, Meierhenry attributed to inadequacies in the test instruments used in these studies. In the research of May and Lumsdaine (1958), differences in intelligence were usually controlled by matching rather than experimentally manipulated. However, some information concerning interrelationships between intelligence and other factors affecting film learning is available from their work. They suggested that previous knowledge of the subject matter, a factor found important in their studies, was positively correlated with intelligence and therefore involved in most studies of intelligence and film learning. Low positive correlations between IQ and pretested attitude toward the subject matter of certain films were also reported. Sekerak's (1957) investigation of use of the mass media indicated that general intelligence is related to the use of all mass media but especially the printed media. Time spent in moviegoing was found to be related to nonlanguage mental ability.

Some evidence with respect to more specific aspects of mental ability has also been reported. Hoban and Van Ormer (1950) have cited a few studies dealing with language facility. Wittich and Fowlkes (1946) found high positive correlations between reading ability scores and learning from films among grade school pupils. Other investigations (Goldstein, 1940; Larsen and Feder, 1940; Anderson and Fairbanks, 1937) have shown that reading comprehension and listening comprehension are highly, but not perfectly, correlated among both children and adults. Further, poorer readers were generally found to have larger listening vocabularies than reading vocabularies. It might be hypothesized that, for individuals whose listening comprehension is superior to their reading comprehension, sound film is an especially appropriate medium of instruction. Park (1943, 1944, 1945) has demonstrated that vocabulary size is correlated with amount learned from films. However, using three narrations which differed in terms of Dale-Chall difficulty level for the same film, Molstad (1955) found no differences in learning among seventh grade children receiving the different versions when an English achievement test was used as covariate. May and Lumsdaine (1958) have also presented interesting findings concerning the relationship between reading comprehension and learning from films. They have shown that viewing films, particularly those which perform an enrichment or experience-broadening function, tends to result in increases in measured reading comprehension. Although this effect was found to be due in part to differences in the teaching of reading, the superiority of the film groups could not be explained completely without consideration of the effects of the films.

One study by Radlow (1955) provides information on some of the individual dimensions of mental ability. Using the Guilford-Zimmerman Aptitude Survey, measures of Verbal Comprehension, General Reasoning, Perceptual Speed, Spatial Orientation, and Spatial Visualization were obtained for approximately 80 military trainees. These variables were then correlated with film learning gain scores. Although no single variables consistently offered the highest correlation with film learning for the two films used, the highest single correlation was obtained with the Verbal Comprehension factor (r = .53). The Spatial Visualization factor also correlated relatively highly with the measures of learning. For purposes of selecting superior film learners, the author suggested that Verbal Comprehension, General Reasoning, and Spatial Orientation would provide a generally satisfactory battery.

Past Experience and Previous Knowledge Factors

It is difficult to separate the effects of intelligence and educational level from those of past experience with films and previous knowledge of the subject matter taught. Interrelationships which have been found between previous knowledge and intelligence, and between past experience with films and reading comprehension were mentioned above. There have been some findings dealing more specifically with past experience and previous knowledge and with some related, special abilities, however, and these are presented in this section.

Hovland, Lumsdaine, and Sheffield (1949) reported that increases in amount of new material learned from a film were related to the amount of previous knowledge held by the subjects before viewing the films. They were unable to control adequately for differences in educational level and learning ability in determining this relationship, however. Ash (1949) showed that previous training in physics aided Navy trainees in learning from films on engineering subjects but that, with other films, trainees who reported having studied previously the material presented in the films did not differ from those who said they had not studied the relevant material. May and Lumsdaine (1958) have also shown that subjects with prior knowledge of the subject matter learned more from films, relative to the amount of information not previously known, than did individuals without previous knowledge.

With respect to past experience in viewing and learning from films, relatively little is known. Some findings indicate, however, that past experience, or some special perceptual abilities related to past experience, do affect subsequent film learning beneficially. These factors have been collectively referred to as "film literacy" by Hoban and Van Ormer (1950).

A study by the Australian Commonwealth Office of Education (1950) correlated frequency of movie attendance with retention of film-learned material, partialling out the effects of intelligence and previous knowledge of the material. The correlation, obtained by relating average scores of a number of groups on these variables rather than relating individual scores, was reported as .985. It is not possible to determine what this correlation would be using individual data rather than group data. Hansen (1939) studied learning from subsequent films as a function of different methods of learning from an initial set of films. He found that a group of high school biology students who had previously viewed four sound films learned significantly more from two silent films presented later than did groups originally viewing some or all of the four films without the sound tracks. Hoban and Van Ormer (1950), in reviewing this study, suggested that viewing the sound films brought about more film literacy even though the sound condition would seem to offer less transfer to the subsequent, silent films than would the original silent showings. Vandermeer (1951) has shown that high school science students taught exclusively with films scored higher on tests following an additional four films on different general subjects than did groups taught with both films and study guides or with conventional lecture methods.

Thus, Miller (1957) has stated that the more past experience an individual has had with properly used instructional films the more he should benefit from subsequent film instruction. Justification for this view is also available from research in other areas of learning. Harlow (1949) has emphasized the importance, and the current neglect, of the experience variable in learning research. He demonstrated that transfer of training occurs from problem to problem within a set of similar problems so that the subject develops a learning set for similar types of learning situations; the individual learns how to learn efficiently. Bateson and Ruesch (1951, pp. 215-216) coined the term "deutero-learning" to refer to this process and suggested that "...there is likely to be a phenomenon of deutero-learning for each type of learning experiment: the experimental subject learning to deal with the particular type of sequential context of which he has had repeated experience." Other than that reported above, however, no additional evidence has been presented for the existence of this cumulative effect of practice in learning from films.

One study has attacked the film literacy hypothesis more specifically. Mercer (1952) developed a film literacy test to measure knowledge of and familiarity with various cinematic techniques. The correlation obtained between this test and the amount learned from a film was .33 among 288 Air Force subjects with Otis intelligence scores partialled out. However, an illustrated lecture on cinematic techniques did not improve subsequent film learning as compared with a no-lecture, control condition. Further, the presence or absence of special optical effects in the films was not found to affect learning under either condition of pretraining.

APPENDIX B

PHYSICS PERSONAL INVENTORY

Please fill in the blanks below. This information will be used for research purposes. It will not influence your grade in this or any other course.

1., 2., 3. Name________________________ 4. Age__________ 5. Sex______
Last First Middle

6. Marital Status__________ 7. Military Service______________________
Vet, Non-Vet, or currently enlisted

8., 9. Location of High School Attended______________________________
City State Country

(For the following questions, indicate your answer by placing a check mark to the right of the appropriate response.)

10. In connection with my courses at Purdue I use the Audio-Visual Center's Film Library

very frequently____; frequently____; sometimes____; seldom____; never____.

11. I attend public movie theaters and/or other entertainment films

very frequently____; frequently____; sometimes____; seldom____; never____.

12. Courses I have taken in high school and college have used instructional films in class

very frequently____; frequently____; sometimes____; seldom____; never____.

(The following statements are sometimes made about instructional films, films and movies in general, and the study of physics. Indicate the extent to which you agree or disagree with each statement by placing a check mark in the appropriate column. If your answer to question 12 was "never", skip questions 13-18.)

Statements About Instructional Films	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
13. I believe every course could be improved by the use of instructional films.	___	___	___	___	___
14. Films can do a lot more teaching than most people realize.	___	___	___	___	___
15. Films can show students what the important points are.	___	___	___	___	___

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
16. Instructional films are poor substitutes for the real thing.	___	___	___	___	___
17. It's a waste of time to try to learn by watching classroom films.	___	___	___	___	___
18. I don't believe in the use of films for teaching.	___	___	___	___	___
Statements About Films and Movies in General					
19. Movies are a strong influence for right living.	___	___	___	___	___
20. Movies encourage social improvement.	___	___	___	___	___
21. The movies are a very relaxing form of entertainment.	___	___	___	___	___
22. Movies have positively no value.	___	___	___	___	___
23. The motion picture industry is an enemy of truth.	___	___	___	___	___
24. Movies do more harm than good.	___	___	___	___	___
Statements About Physics					
25. Knowledge of physics has great value.	___	___	___	___	___
26. Physics is profitable to everyone who studies it.	___	___	___	___	___
27. I expect the study of physics to be very interesting.	___	___	___	___	___
28. I am not interested in physics.	___	___	___	___	___
29. I see no value in the study of physics.	___	___	___	___	___
30. The study of physics is a waste of time.	___	___	___	___	___

Please fill in the blanks below. This information will be used for research purposes. It will not influence your grade in this or any other course.

1. Name______________________________________
   Last First Middle

2. Physics 152 Lecture Section_______________
   Day Time

3. In connection with my courses at Purdue I used the Audio-Visual Center's Film Library approximately __________ times in the past 12 months.

4. I attended public movie theaters and/or other entertainment films approximately __________ times in the past 12 months.

Table 25

Comparison of Response Distributions for Two Past Experience Question Formats

Past Use of Purdue Film Library

Self-reported Frequency Question	Categorical Frequency Question					
	Very Frequently	Frequently	Sometimes	Seldom	Never	Total
Users	0	0	12	18	41	71
Non-users	0	3	6	37	290	336
Total	0	3	18	55	331	407

Past Experience with Entertainment Films

	Very Frequently	Frequently	Sometimes	Seldom	Never	Total
High 25%	2	28	57	9	0	96
Middle 50%	0	37	96	43	8	184
Low 25%	0	5	47	49	4	105
Total	2	70	200	101	12	385

Table 26

Means ($\overline{x}$) and Standard Deviations (σ) for Self-reported Frequency of Film Experience within Each Categorical Frequency Group

Past Experience Variable		Very Frequently	Frequently	Sometimes	Seldom	Never
Past Use of Purdue Film Library	N	0	3	18	55	331
	$\overline{x}$	-	7.67	3.28	.56	.59
	σ	-	10.69	4.46	1.01	2.93
Past Experience with Entertainment Films	N	2	70	200	101	12
	$\overline{x}$	40.00	16.90	12.40	6.76	5.50
	σ	28.28	11.95	11.47	6.87	4.96

APPENDIX C

Table 27

Results of Chi-Square Tests (χ^2) of Independence of BC Cell Samples for Quiz Total Score (QTS), Special Exam Question Score (SEQS), and Quiz Subtotal Scores (QSTS) Analyses in Each Analysis of Variance (ANOV)

ANOV designated by			
Independent variable used as Factor C	Dependent variable used	df	χ^2
Attitude toward instructional films	QTS	4	1.49
" " " "	SEQS	4	1.67
Attitude toward entertainment films	QTS	4	6.84
" " " "	SEQS	4	6.99
Attitude toward physics	QTS	4	1.71
" " "	SEQS	4	2.16
Ascendancy	QTS	4	6.77
"	SEQS	4	6.08
Responsibility	QTS	4	6.62
"	SEQS	4	6.34
Emotional Stability	QTS	4	6.72
" "	SEQS	4	5.03
Sociability	QTS	4	6.11
"	SEQS	4	7.01
Total Score - Gordon Personal Profile	QTS	4	5.05
" " - " " "	SEQS	4	4.77
Numerical Aptitude	QTS	4	18.18**
" "	SEQS	4	16.65**
Verbal Aptitude	QTS	4	31.05**
" "	SEQS	4	28.90**
Academic Achievement	QTS	4	23.18**
" "	SEQS	4	23.48**
Past Experience with instructional films	QTS	4	.25
" " " " "	SEQS	4	.24
" " " " "	QSTS(1-5)		
" " " " "	QSTS(6-10)	4	.90
" " " " "	QSTS(11-14)		
Past Use of Purdue Film Library	QTS	2	.02
" " " " " "	SEQS	2	.03
" " " " " "	QSTS(1-5)		
" " " " " "	QSTS(6-10)	2	1.46
" " " " " "	QSTS(11-14)		
Past Experience with entertainment films	QTS	4	2.63
" " " " "	SEQS	4	2.49
" " " " "	QSTS(1-5)		
" " " " "	QSTS(6-10)	4	5.43
" " " " "	QSTS(11-14)		

** = Significant at .01 level

Table 28

Results of Bartlett's Tests (B) of Homogeneity of Variance for Quiz Total Score (QTS), Special Exam Question Score (SEQS), and Quiz Subtotal Scores (QSTS) in Each Analysis of Variance (ANOV)

ANOV designated by				
Independent variable used as Factor C	Dependent variable used	df	B'	B
Attitude toward instructional films	QTS	17	25.69	
" " " "	SEQS	17	24.87	
Attitude toward entertainment films	QTS	17	20.76	
" " " "	SEQS	17	12.11	
Attitude toward physics	QTS	17	23.14	
" " "	SEQS	17	18.24	
Ascendancy	QTS	17	23.53	
"	SEQS	17	14.67	
Responsibility	QTS	17	35.51**	34.76**
"	SEQS	17	14.79	
Emotional Stability	QTS	17	36.81**	36.00**
" "	SEQS	17	22.16	
Sociability	QTS	17	32.63	
"	SEQS	17	21.47	
Total Score - Gordon Personal Profile	QTS	17	28.35	
" " - " " "	SEQS	17	16.58	
Numerical Aptitude	QTS	17	34.18**	33.48**
" "	SEQS	17	15.16	
Verbal Aptitude	QTS	17	34.51**	33.72**
" "	SEQS	17	9.92	
Academic Achievement	QTS	17	29.90	
" "	SEQS	17	14.91	
Past Experience with instructional films	QTS	17	16.24	
" " " " "	SEQS	17	13.25	
" " " " "	QSTS(1-5)	17	27.06	
" " " " "	QSTS(6-10)	17	20.72	
" " " " "	QSTS(11-14)	17	22.93	
Past use of Purdue Film Library	QTS	11	25.53**	25.00**
" " " " " "	SEQS	11	20.43	
" " " " " "	QSTS(1-5)	11	7.66	
" " " " " "	QSTS(6-10)	11	16.73	
" " " " " "	QSTS(11-14)	11	4.64	
Past Experience with entertainment films	QTS	17	27.79	
" " " " "	SEQS	17	17.38	
" " " " "	QSTS(1-5)	17	12.77	
" " " " "	QSTS(6-10)	17	21.67	
" " " " "	QSTS(11-14)	17	16.84	

** = Significant at .01 level

Table 29

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Attitude Toward Instructional Films as Factor C

Previous Knowledge of Physics

Attitude Toward Instructional Films			High group(b_3)		Middle group(b_2)		Low group(b_1)	
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High (c_3) Group	n	18	29	20	19	28	25	
	$\overline{X}$	107.44	112.28	100.90	100.47	98.29	91.76	611.14
	σ	17.69	16.70	13.54	11.86	15.05	21.54	
Middle (c_2) Group	n	32	31	28	26	24	31	
	$\overline{X}$	106.88	109.48	99.68	100.38	95.75	101.48	613.66
	σ	15.16	16.58	15.29	16.89	11.03	13.70	
Low (c_1) Group	n	26	15	18	15	21	15	
	$\overline{X}$	115.77	109.60	99.22	102.87	94.29	107.33	629.08
	σ	19.07	19.69	15.84	9.77	13.27	16.22	
	$\Sigma \overline{X}$	330.09	331.36	299.80	303.72	288.32	300.58	1853.87

AC summary table

	(a_2)	(a_1)
(c_3)	306.63	304.51
(c_2)	302.30	311.35
(c_1)	309.28	319.80
$\Sigma \overline{X}$	918.21	935.66

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	219.72	201.37	190.05
(c_2)	216.36	200.06	197.23
(c_1)	225.37	202.09	201.62
$\Sigma \overline{X}$	661.45	603.53	588.90

Table 30

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Attitude Toward Instructional Films as Factor C

		Previous Knowledge of Physics						
Attitude Toward Instructional Films		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	16	27	19	18	26	25	
(c_3)	$\bar{X}$	43.31	39.33	39.63	39.39	34.04	35.16	230.86
Group	σ	6.62	9.19	10.90	10.08	6.37	11.82	
Middle	n	32	30	25	22	24	31	
(c_2)	$\bar{X}$	41.81	40.07	35.48	39.27	35.92	36.13	228.68
Group	σ	9.19	9.51	6.48	9.59	9.78	7.44	
Low	n	24	15	18	15	20	14	
(c_1)	$\bar{X}$	42.29	43.73	37.39	37.33	35.30	39.57	235.62
Group	σ	11.27	10.99	9.07	9.00	8.02	10.60	
	$\Sigma \bar{X}$	127.42	123.13	112.50	115.99	105.26	110.86	695.16

AC summary table

	(a_2)	(a_1)
(c_3)	116.98	113.88
(c_2)	113.21	115.47
(c_1)	114.98	120.64
$\Sigma \bar{X}$	345.17	349.99

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	82.65	79.02	69.20
(c_2)	81.88	74.75	72.05
(c_1)	86.02	74.72	74.87
$\Sigma \bar{X}$	250.55	228.50	216.12

Table 31

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Attitude Toward Entertainment Films as Factor C

Previous Knowledge of Physics

Attitude Toward Entertainment Films		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High	n	14	24	16	14	16	29	
(c_3)	$\overline{X}$	104.50	112.00	96.56	98.14	97.69	98.00	606.89
Group	σ	19.53	16.03	14.91	13.15	16.01	23.04	
Middle	n	34	31	30	29	41	34	
(c_2)	$\overline{X}$	110.88	106.03	101.47	100.69	96.00	98.85	613.92
Group	σ	17.75	18.80	14.84	14.29	13.35	13.39	
Low	n	27	19	21	19	19	10	
(c_1)	$\overline{X}$	111.33	115.58	98.10	104.05	98.26	102.50	629.82
Group	σ	16.12	14.50	16.07	13.97	14.48	16.02	
	$\Sigma \overline{X}$	326.72	333.61	296.12	302.89	291.95	299.35	1850.64

AC summary table

	(a_2)	(a_1)
(c_3)	298.75	308.14
(c_2)	308.35	305.57
(c_1)	307.69	322.13
$\Sigma \overline{X}$	914.79	935.85

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	216.50	194.71	195.69
(c_2)	216.91	202.16	194.85
(c_1)	226.91	202.15	200.76
$\Sigma \overline{X}$	660.33	599.01	591.30

Table 32

Cell Frequencies (n), Means ($\overline{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Attitude Toward Entertainment Films as Factor C

Attitude Toward Entertainment Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High (c_3) Group	n	13	24	14	12	14	29	
	$\overline{X}$	40.77	40.38	34.79	38.58	33.64	38.03	226.19
	σ	7.76	9.06	6.53	9.68	10.23	9.45	
Middle (c_2) Group	n	32	28	28	28	40	33	
	$\overline{X}$	43.38	41.71	35.61	39.07	35.92	34.94	230.63
	σ	9.94	9.46	10.36	10.21	8.52	10.47	
Low (c_1) Group	n	26	19	20	17	19	10	
	$\overline{X}$	41.50	39.00	40.55	40.12	33.37	34.70	229.24
	σ	9.61	11.34	7.81	9.25	6.86	9.96	
	$\Sigma \overline{X}$	125.64	121.09	110.94	117.77	102.94	107.67	686.06

AC summary table

	(a_2)	(a_1)
(c_3)	109.20	116.99
(c_2)	114.91	115.73
(c_1)	115.42	113.54
$\Sigma \overline{X}$	339.52	346.54

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	18.14	73.37	71.68
(c_2)	85.09	74.68	70.86
(c_1)	80.50	80.67	68.07
$\Sigma \overline{X}$	246.73	228.72	210.61

Table 33

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Attitude Toward Physics as Factor C

Attitude Toward Physics		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High	n	17	21	18	15	20	23	
(c_3)	$\overline{X}$	104.71	110.00	99.33	102.60	96.25	94.74	607.63
Group	σ	17.44	19.20	13.33	12.55	13.54	22.41	
Middle	n	44	33	35	30	33	33	
(c_2)	$\overline{X}$	110.89	110.55	100.34	100.70	98.94	100.52	621.93
Group	σ	17.73	17.15	15.20	13.74	10.79	16.52	
Low	n	15	21	15	17	24	17	
(c_1)	$\overline{X}$	113.67	111.24	96.73	100.65	96.12	101.88	620.29
Group	σ	16.33	15.53	17.27	15.90	16.65	13.30	
	$\Sigma \overline{X}$	329.26	331.78	296.41	303.95	291.31	297.14	1849.85

AC summary table

	(a_2)	(a_1)
(c_3)	300.29	307.34
(c_2)	310.17	311.76
(c_1)	306.52	313.77
$\Sigma \overline{X}$	916.98	932.87

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	214.71	201.93	190.99
(c_2)	221.43	201.04	199.45
(c_1)	224.90	197.38	198.01
$\Sigma \overline{X}$	661.04	600.36	588.45

Table 34

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Attitude Toward Physics as Factor C

Previous Knowledge of Physics

Attitude Toward Physics		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	17	19	17	13	19	23	
(c_3)	$\bar{X}$	38.82	36.47	36.76	40.31	31.16	37.00	220.53
Group	σ	5.78	10.08	10.32	10.19	7.10	8.39	
Middle	n	42	33	32	27	32	33	
(c_2)	$\bar{X}$	43.40	41.39	38.03	40.67	35.34	37.00	235.84
Group	σ	10.28	8.45	7.90	10.07	9.10	11.47	
Low	n	13	20	14	17	24	16	
(c_1)	$\bar{X}$	43.31	43.05	35.14	36.29	37.04	33.19	228.02
Group	σ	9.50	10.58	9.88	8.41	7.63	8.70	
	$\Sigma \bar{X}$	125.54	120.92	109.94	117.27	103.54	107.19	684.39

AC summary table

	(a_2)	(a_1)
(c_3)	106.75	113.78
(c_2)	116.78	119.06
(c_1)	115.49	112.53
$\Sigma \bar{X}$	339.02	345.37

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	75.30	77.07	68.16
(c_2)	84.80	78.70	72.34
(c_1)	86.36	71.44	70.23
$\Sigma \bar{X}$	246.45	227.21	210.73

Table 35

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Ascendancy as Factor C

		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Ascendancy		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	18	13	26	9	17	11	
(c_3)	$\bar{X}$	112.00	119.85	97.38	106.78	97.29	103.00	636.30
Group	σ	17.78	13.32	13.11	11.01	10.14	18.21	
Middle	n	36	29	21	28	38	39	
(c_2)	$\bar{X}$	107.47	110.48	98.14	102.82	99.37	96.46	614.75
Group	σ	19.11	16.37	16.58	13.42	12.56	19.70	
Low	n	14	23	12	15	13	14	
(c_1)	$\bar{X}$	116.71	108.43	107.58	99.73	96.77	100.64	629.88
Group	σ	14.18	16.71	13.89	12.76	15.83	15.08	
	$\Sigma \bar{X}$	336.19	338.76	303.11	309.33	293.43	300.10	1880.93

AC summary table

	(a_2)	(a_1)
(c_3)	306.68	329.62
(c_2)	304.98	309.77
(c_1)	321.07	308.81
$\Sigma \bar{X}$	932.73	948.20

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	231.85	204.16	200.29
(c_2)	217.96	200.96	195.83
(c_1)	225.15	207.32	197.41
$\Sigma \bar{X}$	674.95	612.44	593.54

Table 36

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Ascendancy as Factor C

			Previous Knowledge of Physics						
			High group(b_3)		Middle group(b_2)		Low group(b_1)		
Ascendancy			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High		n	18	13	25	9	17	11	
	(c_3)	X	43.22	43.54	37.28	43.11	35.29	35.64	238.08
Group		σ	9.32	11.11	9.04	11.58	6.70	7.74	
Middle		n	34	28	20	26	36	39	
	(c_2)	X	40.65	38.50	37.65	38.00	35.50	35.51	225.81
Group		σ	9.46	9.42	6.42	8.88	8.54	10.22	
Low		n	13	21	11	14	13	14	
	(c_1)	X	44.85	43.00	37.18	39.21	36.46	35.93	236.63
Group		σ	9.49	8.07	12.02	9.91	7.01	9.87	
		$\Sigma \bar{X}$	128.72	125.04	112.11	120.33	107.26	107.08	700.52

AC summary table

	(a_2)	(a_1)
(c_3)	115.80	122.29
(c_2)	113.80	112.01
(c_1)	118.49	118.14
$\Sigma \bar{X}$	348.08	352.44

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	86.76	80.39	70.93
(c_2)	79.15	75.65	71.01
(c_1)	87.85	76.40	72.39
$\Sigma \bar{X}$	253.75	232.44	214.33

Table 37

Cell Frequencies (n), Means ($\overline{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Responsibility as Factor C

		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Responsibility		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High	n	17	13	10	15	19	15	
(c_3)	$\overline{X}$	116.94	106.85	95.70	106.27	105.63	98.00	629.39
Group	σ	18.79	14.79	19.13	15.59	11.82	26.67	
Middle	n	28	31	35	29	35	29	
(c_2)	$\overline{X}$	108.29	111.19	100.63	99.52	95.14	93.31	608.08
Group	σ	19.31	16.12	14.83	10.63	11.42	13.56	
Low	n	23	21	14	8	14	20	
(c_1)	$\overline{X}$	108.65	115.24	100.36	107.00	96.50	106.40	634.15
Group	σ	15.15	17.22	12.02	13.06	13.07	15.08	
	$\Sigma \overline{X}$	333.88	333.28	296.69	312.78	297.27	297.71	1871.61

AC summary table

	(a_2)	(a_1)
(c_3)	318.27	311.11
(c_2)	304.06	304.02
(c_1)	305.51	328.64
$\Sigma \overline{X}$	927.84	943.77

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	223.79	201.97	203.63
(c_2)	219.48	200.15	188.45
(c_1)	223.89	207.36	202.90
$\Sigma \overline{X}$	667.16	609.47	594.98

Table 38

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Responsibility as Factor C

Previous Knowledge of Physics

Responsibility		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\overline{X}$
High (c_3) Group	n	16	12	10	15	18	15	
	$\overline{X}$	45.19	37.83	40.40	41.40	36.39	38.33	239.54
	σ	10.67	8.47	11.35	9.53	9.17	7.30	
Middle (c_2) Group	n	27	30	33	27	34	29	
	$\overline{X}$	42.96	41.43	36.12	36.41	34.74	34.10	225.76
	σ	9.42	9.58	8.71	8.41	6.93	10.52	
Low (c_1) Group	n	22	20	13	7	14	20	
	$\overline{X}$	39.09	42.50	38.31	45.86	36.86	35.80	238.41
	σ	7.91	10.01	6.12	11.48	7.83	9.76	
	$\Sigma\overline{X}$	127.24	121.77	114.83	123.66	107.98	108.24	703.72

AC summary table

	(a_2)	(a_1)
(c_3)	121.98	117.57
(c_2)	113.82	111.94
(c_1)	114.26	124.16
$\Sigma\overline{X}$	350.05	353.67

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	83.02	81.80	74.72
(c_2)	84.40	72.53	68.84
(c_1)	81.59	84.16	72.66
$\Sigma\overline{X}$	249.01	238.49	216.22

Table 39

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Emotional Stability as Factor C

Previous Knowledge of Physics

Emotional Stability		High group(b_3)		Middle group(b_2)		Low group(b_1)		$\Sigma \bar{X}$
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	
High	n	19	21	9	15	14	12	
(c_3)	$\bar{X}$	111.58	112.57	102.89	102.07	96.79	93.08	618.97
Group	σ	15.66	14.66	19.16	17.10	13.71	14.88	
Middle	n	30	32	34	28	42	34	
(c_2)	$\bar{X}$	109.17	110.59	98.18	101.50	99.71	98.32	617.47
Group	σ	21.88	18.68	14.05	11.12	13.14	21.02	
Low	n	19	12	16	9	12	18	
(c_1)	$\bar{X}$	111.79	112.75	101.25	107.00	95.42	102.44	630.65
Group	σ	13.51	12.61	14.58	9.66	8.73	14.97	
	$\Sigma \bar{X}$	332.54	335.92	302.32	310.57	291.92	293.85	1867.10

AC summary table

	(a_2)	(a_1)
(c_3)	311.25	307.72
(c_2)	307.06	310.42
(c_1)	308.46	322.19
$\Sigma \bar{X}$	926.77	940.33

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	224.15	204.96	189.87
(c_2)	219.76	199.68	198.04
(c_1)	224.54	208.25	197.86
$\Sigma \bar{X}$	668.45	612.88	585.77

Table 40

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Emotional Stability as Factor C

Previous Knowledge of Physics

Emotional Stability		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\overline{X}$
High	n	19	20	8	14	14	12	
(c_3)	$\overline{X}$	43.84	40.70	40.00	40.57	35.57	32.75	233.43
Group	σ	10.47	7.91	12.00	11.56	8.23	12.21	
Middle	n	30	30	32	27	40	34	
(c_2)	$\overline{X}$	41.47	41.30	37.97	37.15	36.55	36.03	230.46
Group	σ	9.80	9.71	8.25	7.20	7.96	8.07	
Low	n	16	12	16	8	12	18	
(c_1)	$\overline{X}$	41.62	41.17	34.94	44.25	32.67	36.78	231.42
Group	σ	7.60	12.05	7.81	12.33	5.85	10.62	
	$\Sigma\overline{X}$	126.93	123.17	112.91	121.97	104.79	105.56	695.32

AC summary table

	(a_2)	(a_1)
(c_3)	119.41	114.02
(c_2)	115.99	114.48
(c_1)	109.23	122.19
$\Sigma\overline{X}$	344.63	350.69

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	84.54	80.57	68.32
(c_2)	82.77	75.12	72.58
(c_1)	82.79	79.19	69.44
$\Sigma\overline{X}$	250.10	234.88	210.35

Table 41

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Sociability as Factor C

		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Sociability		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High (c_3) Group	n	14	12	19	14	21	11	
	$\bar{X}$	104.21	117.00	98.84	102.43	98.95	101.73	623.16
	σ	19.01	17.91	11.93	13.18	9.83	14.92	
Middle (c_2) Group	n	38	29	29	25	35	38	
	$\bar{X}$	110.68	113.00	98.31	103.32	97.31	95.68	618.31
	σ	17.63	13.14	15.45	13.62	12.34	21.22	
Low (c_1) Group	n	16	24	11	13	12	15	
	$\bar{X}$	115.88	107.29	105.00	101.46	100.33	103.27	633.23
	σ	17.26	18.31	17.96	11.72	17.53	11.39	
	$\Sigma \bar{X}$	330.77	337.29	302.15	307.21	296.60	300.68	1874.71

AC summary table

	(a_2)	(a_1)
(c_3)	302.01	321.16
(c_2)	306.31	312.00
(c_1)	321.21	312.02
$\Sigma \bar{X}$	929.53	945.18

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	221.21	201.27	200.68
(c_2)	223.68	201.63	193.00
(c_1)	223.17	206.46	203.60
$\Sigma \bar{X}$	668.07	609.36	597.28

Table 42

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Sociability as Factor C

Previous Knowledge of Physics

		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Sociability		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group (c_3)	$\underline{n}$	12	12	19	14	19	11	
	$\bar{X}$	41.92	46.25	36.53	39.50	35.00	37.82	237.01
	σ	6.73	12.02	6.03	10.12	6.55	10.51	
Middle Group (c_2)	$\underline{n}$	37	29	27	23	35	38	
	$\bar{X}$	41.27	39.97	36.19	39.48	35.91	33.95	228.66
	σ	9.50	7.49	8.89	10.39	8.45	9.85	
Low Group (c_1)	$\underline{n}$	16	21	10	12	12	15	
	$\bar{X}$	44.56	39.67	36.90	38.67	35.83	38.53	234.16
	σ	11.05	9.92	12.69	8.42	7.73	7.74	
	$\Sigma \bar{X}$	127.75	125.88	111.61	117.64	106.75	110.19	699.83

AC summary table

	(a_2)	(a_1)
(c_3)	113.44	123.57
(c_2)	115.37	113.29
(c_1)	117.30	116.87
$\Sigma \bar{X}$	346.11	353.72

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	88.17	76.03	72.82
(c_2)	81.24	77.66	69.76
(c_1)	84.23	75.57	74.37
$\Sigma \bar{X}$	253.63	229.26	216.94

Table 43

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Total Score - GPP as Factor C

Previous Knowledge of Physics

Total Score - GPP		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	16	13	15	13	24	15	
(c_3)	$\bar{X}$	114.50	114.08	100.47	102.85	101.00	90.60	623.49
Group	σ	15.12	14.71	13.92	15.51	10.16	23.84	
Middle	n	36	30	30	32	31	30	
(c_2)	$\bar{X}$	107.36	111.93	96.23	103.22	95.87	99.50	614.12
Group	σ	20.34	16.81	15.45	12.53	12.85	16.70	
Low	n	16	22	14	7	13	19	
(c_1)	$\bar{X}$	113.88	109.77	106.43	99.43	99.38	103.16	632.05
Group	σ	14.08	16.88	13.03	9.61	15.51	14.99	
	$\Sigma \bar{X}$	335.74	335.78	303.13	305.49	296.26	293.26	1869.65

AC summary table

	(a_2)	(a_1)
(c_3)	315.97	307.52
(c_2)	299.47	314.65
(c_1)	319.69	312.36
$\Sigma \bar{X}$	935.12	934.53

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	228.58	203.31	191.60
(c_2)	219.29	199.45	195.37
(c_1)	223.65	205.86	202.54
$\Sigma \bar{X}$	671.52	608.62	589.51

Table 44

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Total Score - GPP as Factor C

Previous Knowledge of Physics

Total Score - GPP		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High (c_3) Group	n	16	13	14	13	23	15	
	$\bar{X}$	46.44	41.31	39.93	38.85	34.35	34.40	235.27
	σ	7.18	9.41	10.02	8.26	6.89	8.17	
Middle (c_2) Group	n	34	28	29	30	30	30	
	$\bar{X}$	39.71	40.32	36.31	39.67	36.70	36.00	228.70
	σ	9.63	9.70	6.75	10.49	8.89	10.09	
Low (c_1) Group	n	15	21	13	6	13	19	
	$\bar{X}$	43.33	41.95	37.08	38.33	35.46	36.00	232.16
	σ	9.80	9.72	11.13	9.71	6.20	10.33	
	$\Sigma \bar{X}$	129.48	123.58	113.32	116.85	106.51	106.40	696.13

AC summary table

	(a_2)	(a_1)
(c_3)	120.71	114.55
(c_2)	112.72	115.99
(c_1)	115.87	116.29
$\Sigma \bar{X}$	349.30	346.83

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	87.75	78.77	68.75
(c_2)	80.03	75.98	72.70
(c_1)	85.29	75.41	71.46
$\Sigma \bar{X}$	253.06	230.16	212.91

Table 45

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Numerical Aptitude as Factor C

Previous Knowledge of Physics

Numerical Aptitude			High group(b_3)		Middle group(b_2)		Low group(b_1)		
			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group	(c_3)	n	26	27	11	14	21	11	
		$\bar{X}$	111.19	116.15	101.45	106.43	100.71	116.45	652.39
		σ	20.57	15.49	13.49	17.81	10.85	10.52	
Middle Group	(c_2)	n	33	39	35	32	27	45	
		$\bar{X}$	110.94	108.74	102.63	101.12	98.59	97.89	619.92
		σ	15.95	17.16	13.26	11.55	11.63	14.29	
Low Group	(c_1)	n	13	7	24	15	26	13	
		$\bar{X}$	104.77	95.14	93.46	95.40	91.31	89.92	570.00
		σ	15.78	12.65	16.65	13.28	15.96	26.15	
		$\Sigma \bar{X}$	326.90	320.03	297.54	302.95	290.61	304.27	1842.31

AC summary table

	(a_2)	(a_1)
(c_3)	313.36	339.03
(c_2)	312.16	307.76
(c_1)	289.54	280.47
$\Sigma \bar{X}$	915.06	927.25

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	227.34	207.88	217.17
(c_2)	219.68	203.75	196.48
(c_1)	199.91	188.86	181.23
$\Sigma \bar{X}$	646.94	600.50	594.88

Table 46

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Numerical Aptitude as Factor C

Previous Knowledge of Physics

		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Numerical Aptitude		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group (c_3)	n	26	26	11	14	21	11	
	$\bar{X}$	44.54	43.46	35.82	44.64	38.14	41.55	248.15
	σ	10.76	9.23	6.31	10.66	9.08	11.25	
Middle Group (c_2)	n	31	37	33	29	26	44	
	$\bar{X}$	40.90	40.49	39.06	38.83	33.88	35.77	228.94
	σ	8.15	9.52	10.02	9.38	6.73	10.16	
Low Group (c_1)	n	11	7	21	13	24	13	
	$\bar{X}$	41.73	33.00	34.10	35.54	33.79	34.00	212.15
	σ	10.25	8.10	7.75	6.95	8.30	8.51	
	$\Sigma \bar{X}$	127.17	116.95	108.97	119.01	105.82	111.32	689.24

AC summary table

	(a_2)	(a_1)
(c_3)	118.50	129.65
(c_2)	113.85	115.09
(c_1)	109.61	102.54
$\Sigma \bar{X}$	341.96	347.28

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	88.00	80.46	79.69
(c_2)	81.39	77.89	69.66
(c_1)	74.73	69.63	67.79
$\Sigma \bar{X}$	244.12	227.98	217.14

Table 47

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Verbal Aptitude as Factor C

Previous Knowledge of Physics

Verbal Aptitude		High group(b_3) Film(a_2)	High group(b_3) Live(a_1)	Middle group(b_2) Film(a_2)	Middle group(b_2) Live(a_1)	Low group(b_1) Film(a_2)	Low group(b_1) Live(a_1)	$\Sigma \bar{X}$
High	n	27	22	15	15	9	16	
(c_3)	$\bar{X}$	114.15	113.50	99.33	109.67	107.67	105.75	650.06
Group	σ	18.00	21.73	14.08	10.55	14.85	15.08	
Middle	n	37	46	35	27	38	30	
(c_2)	$\bar{X}$	107.97	109.00	100.00	98.59	97.66	101.50	614.72
Group	σ	15.98	13.86	15.17	12.95	12.08	13.32	
Low	n	8	5	20	18	26	23	
(c_1)	$\bar{X}$	104.62	106.40	98.05	97.22	92.08	92.09	590.46
Group	σ	22.86	22.74	15.87	15.63	12.98	23.55	
	$\Sigma \bar{X}$	326.75	328.90	297.38	305.48	297.40	299.34	1855.25

AC summary table

	(a_2)	(a_1)
(c_3)	321.15	328.92
(c_2)	305.63	309.09
(c_1)	294.75	295.71
$\Sigma \bar{X}$	921.53	933.72

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	227.65	209.00	213.42
(c_2)	216.97	198.59	199.16
(c_1)	211.02	195.27	184.16
$\Sigma \bar{X}$	655.65	602.86	596.74

Table 48

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Verbal Aptitude as Factor C

Previous Knowledge of Physics

Verbal Aptitude		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	25	21	15	14	9	16	
(c_3)	$\bar{X}$	43.60	44.62	37.93	41.50	39.00	37.94	244.59
Group	σ	10.76	8.96	10.09	8.63	10.40	10.32	
Middle	n	35	45	33	24	36	30	
(c_2)	$\bar{X}$	41.00	39.38	37.61	41.29	34.86	37.97	232.10
Group	σ	8.67	9.05	8.70	10.10	7.49	9.71	
Low	n	8	4	17	17	25	22	
(c_1)	$\bar{X}$	45.00	37.50	34.65	35.41	34.24	33.05	219.84
Group	σ	9.56	15.80	8.58	9.28	8.26	10.39	
	$\Sigma \bar{X}$	129.60	121.50	110.19	118.20	108.10	108.95	696.54

AC summary table

	(a_2)	(a_1)
(c_3)	120.53	124.06
(c_2)	113.47	118.64
(c_1)	113.89	105.96
$\Sigma \bar{X}$	347.89	348.65

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	88.22	79.43	76.94
(c_2)	80.38	78.90	72.83
(c_1)	82.50	70.06	67.29
$\Sigma \bar{X}$	251.10	228.39	217.05

Table 49

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Academic Achievement as Factor C

		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
Academic Achievement		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	26	27	11	16	9	11	
(c_3)	$\bar{X}$	119.92	118.93	104.73	111.12	109.44	113.00	677.15
Group	σ	15.14	14.75	15.63	13.02	15.39	7.58	
Middle	n	39	34	39	29	38	47	
(c_2)	$\bar{X}$	107.46	108.38	100.36	100.62	100.45	99.91	617.19
Group	σ	15.27	17.29	13.91	10.68	11.17	14.75	
Low	n	10	14	19	16	30	14	
(c_1)	$\bar{X}$	93.80	100.00	95.05	93.62	89.17	85.07	556.72
Group	σ	15.30	13.66	15.83	13.32	12.40	24.41	
	$\Sigma \bar{X}$	321.18	327.31	300.14	305.37	299.06	297.99	1851.05

AC summary table

	(a_2)	(a_1)
(c_3)	334.09	343.05
(c_2)	308.27	308.92
(c_1)	278.02	278.70
$\Sigma \bar{X}$	920.38	930.67

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	238.85	215.85	222.44
(c_2)	215.84	200.98	200.36
(c_1)	193.80	188.68	174.24
$\Sigma \bar{X}$	648.49	605.51	597.04

Table 50

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Academic Achievement as Factor C

Previous Knowledge of Physics

Academic Achievement			High group(b_3)		Middle group(b_2)		Low group(b_1)		
			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\bar{X}$
High Group	(c_3)	n	26	27	11	16	9	11	
		$\bar{X}$	46.42	46.37	42.36	42.81	38.11	44.45	260.54
		σ	8.40	6.51	11.59	9.54	7.46	10.09	
Middle Group	(c_2)	n	37	31	37	28	36	47	
		$\bar{X}$	40.89	39.10	36.81	40.68	35.64	36.00	229.12
		σ	9.81	8.09	7.89	8.75	7.99	8.72	
Low Group	(c_1)	n	8	14	16	13	29	13	
		$\bar{X}$	36.38	33.43	33.69	33.00	32.93	29.54	198.96
		σ	5.50	11.59	8.34	8.73	9.03	10.12	
		$\Sigma\bar{X}$	123.69	118.90	112.86	116.49	106.68	109.99	688.61

AC summary table

	(a_2)	(a_1)
(c_3)	126.90	133.64
(c_2)	113.34	115.78
(c_1)	102.99	95.97
$\Sigma\bar{X}$	343.23	345.38

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	92.79	85.18	82.57
(c_2)	79.99	77.49	71.64
(c_1)	69.80	66.69	62.47
$\Sigma\bar{X}$	242.59	229.35	216.67

Table 51

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Past Experience with Instructional Films as Factor C

Past Experience with Instructional Films		Previous Knowledge of Physics High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	14	18	14	14	15	17	
(c_3)	$\bar{X}$	106.29	110.06	101.29	97.79	95.53	92.76	603.71
Group	σ	14.57	16.44	14.60	14.00	12.30	16.52	
Middle	n	39	41	40	31	43	38	
(c_2)	$\bar{X}$	106.18	110.15	100.25	101.90	97.58	101.37	617.43
Group	σ	17.35	17.49	14.26	14.97	12.66	19.82	
Low	n	23	16	14	16	19	18	
(c_1)	$\bar{X}$	118.91	112.31	94.50	102.62	96.74	99.94	625.03
Group	σ	16.57	17.75	17.68	12.35	18.13	14.24	
	$\Sigma \bar{X}$	331.38	332.51	296.04	302.31	289.85	294.08	1846.17

AC summary table

	(a_2)	(a_1)
(c_3)	303.10	300.61
(c_2)	304.01	313.42
(c_1)	310.15	314.88
$\Sigma \bar{X}$	917.27	928.91

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	216.34	199.07	188.30
(c_2)	216.33	202.15	198.95
(c_1)	231.23	197.13	196.68
$\Sigma \bar{X}$	663.89	598.35	583.93

Table 52

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and
Summary Tables for Special Exam Question Score Using
Past Experience with Instructional Films as Factor C

Past Experience with Instructional Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High (c_3) Group	n	13	17	13	13	14	16	
	$\bar{X}$	39.15	42.24	39.77	39.85	34.50	33.31	228.82
	σ	9.12	7.66	10.82	11.47	7.07	9.66	
Middle (c_2) Group	n	38	40	37	29	42	38	
	$\bar{X}$	41.92	38.68	37.19	39.45	35.10	37.11	229.43
	σ	8.97	9.53	9.05	8.98	8.03	10.05	
Low (c_1) Group	n	21	15	13	14	18	18	
	$\bar{X}$	44.95	43.67	33.92	37.79	34.00	36.67	230.99
	σ	9.91	11.62	5.91	9.94	10.35	10.21	
	$\Sigma \bar{X}$	126.03	124.58	110.88	117.08	103.60	107.08	689.25

AC summary table

	(a_2)	(a_1)
(c_3)	113.42	115.39
(c_2)	114.21	115.23
(c_1)	112.88	118.12
$\Sigma \bar{X}$	340.50	348.74

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	81.39	79.62	67.81
(c_2)	80.60	76.64	72.20
(c_1)	88.62	71.71	70.67
$\Sigma \bar{X}$	250.60	227.96	210.68

Table 53

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (1-5) Using Past Experience with Instructional Films as Factor C

Previous Knowledge of Physics

Past Experience with Instructional Films		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High (c_3) Group	n	9	15	10	9	11	6	
	$\overline{X}$	320.56	307.20	317.00	271.00	279.09	269.00	1763.85
	σ	48.29	73.94	31.64	57.72	83.27	60.10	
Middle (c_2) Group	n	28	29	26	22	35	20	
	$\overline{X}$	313.04	328.97	280.58	302.68	290.11	306.30	1822.67
	σ	58.44	59.60	51.88	76.27	43.61	64.69	
Low (c_1) Group	n	19	10	8	15	14	14	
	$\overline{X}$	353.42	346.70	276.50	306.60	268.57	391.57	1843.36
	σ	58.57	73.28	75.71	35.60	63.34	55.56	
	$\Sigma \overline{X}$	987.01	982.87	874.08	880.28	837.78	867.87	5429.88

AC summary table

	(a_2)	(a_1)
(c_3)	916.65	847.20
(c_2)	883.73	938.95
(c_1)	898.49	944.87
$\Sigma \overline{X}$	2698.87	2731.02

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	627.76	588.00	548.09
(c_2)	642.00	583.26	597.41
(c_1)	700.12	583.10	560.14
$\Sigma \overline{X}$	1969.88	1754.36	1705.65

Table 54

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (6-10) Using Past Experience with Instructional Films as Factor C

Past Experience with Instructional Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group (c_3)	n	9	15	10	9	11	6	
	$\bar{X}$	278.33	285.87	283.00	255.56	256.18	266.50	1625.44
	σ	48.65	59.02	36.53	55.48	27.68	43.24	
Middle Group (c_2)	n	28	29	26	22	35	20	
	$\bar{X}$	279.54	289.90	276.12	274.14	263.89	269.35	1652.92
	σ	57.16	60.58	58.53	34.99	46.68	54.52	
Low Group (c_1)	n	19	10	8	15	14	14	
	$\bar{X}$	323.16	291.00	258.62	263.87	274.93	244.61	1656.51
	σ	63.95	58.96	69.23	46.03	49.41	56.41	
	$\Sigma \bar{X}$	881.03	866.76	817.74	793.56	795.00	780.78	4934.86

AC summary table

	(a_2)	(a_1)
(c_3)	817.52	807.92
(c_2)	819.54	833.38
(c_1)	856.71	799.80
$\Sigma \bar{X}$	2493.76	2441.10

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	564.20	538.56	522.68
(c_2)	569.43	550.25	533.24
(c_1)	614.16	522.49	519.86
$\Sigma \bar{X}$	1747.79	1611.30	1575.77

Table 55

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (11-14) Using Past Experience with Instructional Films as Factor C

Past Experience with Instructional Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group (c_3)	n	9	15	10	9	11	6	
	$\bar{X}$	280.56	280.60	266.60	261.11	241.45	251.83	1582.15
	σ	29.39	49.11	41.87	42.23	49.94	78.59	
Middle Group (c_2)	n	28	29	26	22	35	20	
	$\bar{X}$	278.18	283.28	261.65	276.05	246.51	280.45	1626.12
	σ	53.03	57.89	48.75	33.55	42.87	47.69	
Low Group (c_1)	n	19	10	8	15	14	14	
	$\bar{X}$	300.11	308.10	248.75	264.60	249.43	277.00	1647.98
	σ	39.69	33.13	44.64	44.69	66.32	37.33	
	$\Sigma \bar{X}$	858.84	871.98	777.00	801.76	737.40	809.28	4856.26

AC summary table

	(a_2)	(a_1)
(c_3)	788.61	793.54
(c_2)	786.35	839.77
(c_1)	798.28	849.70
$\Sigma \bar{X}$	2373.24	2483.02

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	561.16	527.71	493.29
(c_2)	561.45	537.70	526.96
(c_1)	608.21	513.35	526.43
$\Sigma \bar{X}$	1730.82	1578.76	1546.68

Table 56

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Past Use of Purdue Film Library as Factor C

Previous Knowledge of Physics

Past Use of Purdue Film Library		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\overline{X}$
High (c_2) Group	n	9	18	8	14	10	17	
	$\overline{X}$	110.78	110.06	105.88	103.14	100.60	95.24	625.69
	σ	17.43	12.31	17.88	11.98	16.17	11.04	
Low (c_1) Group	n	62	50	53	40	61	48	
	$\overline{X}$	110.31	113.02	98.94	101.18	98.00	99.73	621.17
	σ	17.98	17.78	14.08	14.29	12.48	20.25	
	$\Sigma\overline{X}$	221.08	223.08	204.82	204.32	198.60	194.96	1246.86

AC summary table

	(a_2)	(a_1)
(c_2)	317.25	308.43
(c_1)	307.25	313.92
$\Sigma\overline{X}$	624.50	622.36

BC summary table

	(b_3)	(b_2)	(b_1)
(c_2)	220.83	209.02	195.84
(c_1)	223.33	200.12	197.73
$\Sigma\overline{X}$	444.16	409.14	393.56

Table 57

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Past Use of Purdue Film Library as Factor C

Past Use of Purdue Film Library		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High (c_2) Group	n	8	18	8	13	10	17	
	$\bar{X}$	42.75	40.11	43.88	36.23	39.20	33.18	235.34
	σ	11.39	11.18	13.62	6.81	5.51	7.33	
Low (c_1) Group	n	60	47	50	38	59	48	
	$\bar{X}$	41.87	41.89	36.12	39.76	35.05	36.42	231.11
	σ	9.17	8.76	7.57	10.56	7.79	10.16	
	$\Sigma \bar{X}$	84.62	82.00	80.00	75.99	74.25	69.59	466.45

AC summary table

	(a_2)	(a_1)
(c_2)	125.82	109.52
(c_1)	113.04	118.07
$\Sigma \bar{X}$	238.86	227.59

BC summary table

	(b_3)	(b_2)	(b_1)
(c_2)	82.86	80.11	72.38
(c_1)	83.76	75.88	71.47
$\Sigma \bar{X}$	166.62	155.99	143.84

Table 58

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (1-5) Using Past Use of Purdue Film Library as Factor C

Past Use of Purdue Film Library			Previous Knowledge of Physics						
			High group(b_3)		Middle group(b_2)		Low group(b_1)		
			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High Group	(c_2)	n	5	14	7	10	6	7	
		$\overline{X}$	318.80	321.00	284.71	300.90	301.50	290.29	1817.20
		σ	64.87	49.84	48.74	54.19	71.55	71.80	
Low Group	(c_1)	n	48	36	35	32	52	30	
		$\overline{X}$	332.90	334.06	286.34	299.41	283.90	297.60	1834.20
		σ	56.20	69.91	56.56	67.96	52.02	57.96	
		$\Sigma \overline{X}$	651.70	655.06	571.06	600.31	585.40	587.89	3651.40

AC summary table

	(a_2)	(a_1)
(c_2)	905.01	912.19
(c_1)	903.14	931.06
$\Sigma \overline{X}$	1808.16	1843.25

BC summary table

	(b_3)	(b_2)	(b_1)
(c_2)	639.80	585.61	591.79
(c_1)	666.95	585.75	581.50
$\Sigma \overline{X}$	1306.75	1171.36	1173.29

Table 59

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (6-10) Using Past Use of Purdue Film Library as Factor C

		Previous Knowledge of Physics						
Past Use of Purdue Film Library		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \overline{X}$
High (c_2) Group	n	5	14	7	10	6	7	
	$\overline{X}$	323.80	279.79	279.86	268.00	286.67	231.29	1669.40
	σ	43.15	47.62	63.04	30.11	43.67	34.23	
Low (c_1) Group	n	48	36	35	32	52	30	
	$\overline{X}$	291.96	295.53	270.57	262.44	262.77	270.60	1653.86
	σ	62.18	63.96	55.41	45.47	44.80	55.25	
	$\Sigma \overline{X}$	615.76	575.31	550.43	530.44	549.44	501.89	3323.26

AC summary table

	(a_2)	(a_1)
(c_2)	890.32	779.07
(c_1)	825.30	828.57
$\Sigma \overline{X}$	1715.62	1607.64

BC summary table

	(b_3)	(b_2)	(b_1)
(c_2)	603.59	547.86	517.95
(c_1)	587.49	533.01	533.37
$\Sigma \overline{X}$	1191.07	1080.87	1051.32

Table 60

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (11-14) Using Past Use of Purdue Film Library as Factor C

Previous Knowledge of Physics

Past Use of Purdue Film Library			High group(b_3)		Middle group(b_2)		Low group(b_1)		
			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\bar{X}$
High Group	(c_2)	n	5	14	7	10	6	7	
		$\bar{X}$	324.40	276.64	294.71	277.00	273.17	260.29	1706.21
		σ	50.66	43.57	56.40	41.35	56.52	47.53	
Low Group	(c_1)	n	48	36	35	32	52	30	
		$\bar{X}$	284.00	299.81	253.57	263.34	244.90	278.20	1623.82
		σ	46.42	46.61	42.11	39.05	47.78	52.37	
		$\Sigma\bar{X}$	608.40	576.45	548.29	540.34	518.07	538.49	3330.03

AC summary table

	(a_2)	(a_1)
(c_2)	892.28	813.93
(c_1)	782.48	841.35
$\Sigma\bar{X}$	1674.76	1655.28

BC summary table

	(b_3)	(b_2)	(b_1)
(c_2)	601.04	571.71	533.45
(c_1)	583.81	516.92	523.10
$\Sigma\bar{X}$	1184.85	1088.63	1056.56

Table 61

Cell Frequencies (n), Means ($\bar{x}$), Standard Deviations (σ), and Summary Tables for Quiz Total Score Using Past Experience with Entertainment Films as Factor C

Previous Knowledge of Physics

Past Experience with Entertainment Films		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group (c_3)	n	22	13	9	18	22	12	
	X	109.50	106.92	102.89	99.78	95.77	98.42	613.28
	σ	17.95	15.13	12.53	12.49	10.56	11.11	
Middle Group (c_2)	n	29	32	33	23	32	38	
	X	107.28	113.78	97.39	105.09	100.94	96.00	620.48
	σ	17.69	16.76	15.90	15.94	12.72	21.05	
Low Group (c_1)	n	20	23	19	13	16	15	
	X	115.80	113.09	102.68	98.31	98.50	105.33	633.51
	σ	17.38	16.87	13.12	9.78	14.81	14.22	
	$\Sigma \bar{X}$	332.58	333.79	302.97	303.17	295.21	299.50	1867.27

AC summary table

	(a_2)	(a_1)
(c_3)	308.16	305.12
(c_2)	305.61	314.87
(c_1)	316.98	316.53
$\Sigma \bar{X}$	930.75	936.51

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	216.42	202.67	194.19
(c_2)	221.06	202.48	196.94
(c_1)	228.89	200.99	203.63
$\Sigma \bar{X}$	666.37	606.14	594.76

Table 62

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Special Exam Question Score Using Past Experience with Entertainment Films as Factor C

Past Experience with Entertainment Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High	n	20	13	9	18	22	12	
(c_3)	$\bar{X}$	38.75	42.31	36.33	35.94	37.32	33.83	224.49
Group	σ	10.08	5.88	11.79	10.72	7.67	10.00	
Middle	n	28	30	30	21	30	38	
(c_2)	$\bar{X}$	42.04	43.53	35.83	42.33	34.80	35.76	234.30
Group	σ	7.52	8.99	7.85	8.94	7.67	10.31	
Low	n	20	22	19	12	16	15	
(c_1)	$\bar{X}$	45.10	37.95	39.74	37.17	35.31	36.47	231.74
Group	σ	10.31	10.97	8.95	8.58	7.67	7.40	
	$\Sigma \bar{X}$	125.89	123.80	111.90	115.44	107.43	106.06	690.52

AC summary table

	(a_2)	(a_1)
(c_3)	112.40	112.09
(c_2)	112.67	121.63
(c_1)	120.15	111.59
$\Sigma \bar{X}$	345.22	345.30

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	81.06	72.28	71.15
(c_2)	85.57	78.17	70.56
(c_1)	83.05	76.90	71.78
$\Sigma \bar{X}$	249.68	227.35	213.49

Table 63

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (1-5) Using Past Experience with Entertainment Films as Factor C

Past Experience with Entertainment Films			Previous Knowledge of Physics						
			High group(b_3)		Middle group(b_2)		Low group(b_1)		
			Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma \bar{X}$
High Group	(c_3)	n	12	8	6	14	19	8	
		$\bar{X}$	331.50	299.62	322.83	304.36	279.42	286.88	1824.61
		σ	66.80	66.44	53.67	59.36	47.96	43.95	
Middle Group	(c_2)	n	23	24	21	17	27	21	
		$\bar{X}$	328.26	335.08	266.62	309.06	289.67	293.33	1822.02
		σ	49.68	65.71	56.73	71.64	64.10	65.18	
Low Group	(c_1)	n	18	18	15	11	12	8	
		$\bar{X}$	335.83	337.83	298.60	279.55	286.83	313.12	1851.77
		σ	60.49	62.19	42.98	59.52	37.95	62.13	
		$\Sigma \bar{X}$	995.59	972.54	888.05	892.96	855.92	893.33	5498.40

AC summary table

	(a_2)	(a_1)
(c_3)	933.75	890.86
(c_2)	884.55	937.48
(c_1)	921.27	930.50
$\Sigma \bar{X}$	2739.57	2758.84

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	631.12	627.19	566.30
(c_2)	663.34	575.68	583.00
(c_1)	673.67	578.15	599.96
$\Sigma \bar{X}$	1968.14	1781.01	1749.25

Table 64

Cell Frequencies (n), Means ($\overline{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (6-10) Using Past Experience with Entertainment Films as Factor C

Past Experience with Entertainment Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\overline{X}$
High (c_3) Group	n	12	8	6	14	19	8	
	$\overline{X}$	306.25	265.00	286.67	246.21	256.32	245.00	1605.45
	σ	53.49	63.70	51.64	45.34	35.47	27.77	
Middle (c_2) Group	n	23	24	21	17	27	21	
	$\overline{X}$	277.35	304.04	277.10	284.18	263.22	274.19	1680.07
	σ	58.90	55.95	57.04	38.54	49.38	61.00	
Low (c_1) Group	n	18	18	15	11	12	8	
	$\overline{X}$	309.94	285.50	259.33	254.54	283.92	252.38	1645.61
	σ	65.65	61.69	57.38	31.10	45.82	51.24	
	$\Sigma\overline{X}$	893.54	854.54	823.10	784.94	803.45	771.57	4931.14

AC summary table

	(a_2)	(a_1)
(c_3)	849.23	756.21
(c_2)	817.67	862.41
(c_1)	853.19	792.42
$\Sigma\overline{X}$	2520.09	2411.04

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	571.25	532.88	501.32
(c_2)	581.39	561.27	537.41
(c_1)	595.44	513.88	536.29
$\Sigma\overline{X}$	1748.08	1608.03	1575.02

Table 65

Cell Frequencies (n), Means ($\bar{X}$), Standard Deviations (σ), and Summary Tables for Quiz Subtotal Score (11-14) Using Past Experience with Entertainment Films as Factor C

Past Experience with Entertainment Films		Previous Knowledge of Physics						
		High group(b_3)		Middle group(b_2)		Low group(b_1)		
		Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	Film(a_2)	Live(a_1)	$\Sigma\bar{X}$
High Group (c_3)	n	12	8	6	14	19	8	
	$\bar{X}$	305.25	278.88	264.83	248.00	232.58	289.75	1619.29
	σ	39.31	59.87	59.46	43.22	41.14	46.36	
Middle Group (c_2)	n	23	24	21	17	27	21	
	$\bar{X}$	277.00	294.83	254.67	288.18	255.56	268.71	1638.95
	σ	51.27	42.93	45.97	31.95	47.87	59.66	
Low Group (c_1)	n	18	18	15	11	12	8	
	$\bar{X}$	290.00	297.72	266.73	256.91	254.58	275.88	1641.82
	σ	47.08	46.38	44.65	31.09	60.38	29.48	
	$\Sigma\bar{X}$	872.25	871.43	786.23	793.09	742.72	834.34	4900.06

AC summary table

	(a_2)	(a_1)
(c_3)	802.66	816.62
(c_2)	787.22	851.72
(c_1)	811.32	830.51
$\Sigma\bar{X}$	2401.20	2498.86

BC summary table

	(b_3)	(b_2)	(b_1)
(c_3)	584.12	512.83	522.33
(c_2)	571.83	542.84	524.27
(c_1)	587.72	523.64	530.46
$\Sigma\bar{X}$	1743.68	1579.32	1577.06

Table 66

Adjusted Matrix of Intercorrelations and Estimated Communalities

	AIF	A-GPP	R-GPP	PUFL	PXEF	AA	NA	VA	PKP	SEQS	QSTS (1-5)	QSTS (6-10)	QSTS (11-14)
AIF	.07	.02	.00	.02	-.01	-.02	-.05	-.01	-.05	-.04	-.03	-.04	-.07
A-GPP		.05	.00	.02	.01	.01	.00	.00	.01	-.03	-.02	-.01	-.01
R-GPP			.06	.02	-.03	.00	.04	.02	.02	.02	.00	.02	.05
PUFL				.06	-.01	.03	.00	.00	.02	.01	.01	.01	.02
PXEF					.05	.00	.01	-.02	.00	-.02	-.02	-.01	-.03
AA						.40	.21	.23	.25	.32	.26	.30	.31
NA							.24	.18	.18	.22	.16	.18	.26
VA								.21	.15	.22	.18	.19	.23
PKP									.21	.23	.18	.21	.26
SEQS										.34	.25	.28	.32
QSTS (1-5)											.22	.23	.25
QSTS (6-10)												.28	.28
QSTS (11-14)													.39

Table 67

Initial, Unrotated Factor Loadings for First Six Factors

Variable	Factors I	II	III	IV	V	VI...
AIF	-.08	.12	-.17	-.03	-.09	-.02
A-GPP	-.01	.03	-.07	.16	-.08	.05
R-GPP	.04	-.15	-.13	.00	.04	.04
PUFL	.03	.02	-.16	.09	.06	-.10
PXEF	-.02	.04	.15	.09	-.09	-.03
AA	.58	.19	-.02	.08	-.04	.01
NA	.41	-.20	.03	.02	-.16	-.05
VA	.40	.00	-.07	-.12	-.15	.05
PKP	.43	-.02	.03	.14	.05	.00
SEQS	.56	.04	.02	-.08	.03	-.08
QSTS(1-5)	.44	.07	.03	-.08	.03	-.03
QSTS(6-10)	.50	.09	.03	-.01	.07	.08
QSTS(11-14)	.59	-.17	-.04	.03	.07	.02

Table 68

Transformation Matrix for Rotation of Factor Loadings

Factor	I	II	III	IV	V
I	.97	.04	.01	-.06	.05
II	.26	-.59	.10	.48	-.48
III	.02	-.71	-.34	-.55	-.02
IV	-.04	-.14	.88	-.39	-.24
V	-.02	.35	-.31	-.56	-.85

APPENDIX D

INSTRUCTIONAL FILM RATING FORM

Title of Film:____

Evaluator:____

INSTRUCTIONS

This form has been designed to aid in judging objectively the instructional value of the film you have just seen. Please read each item carefully and be as objective as possible in making your judgment. The six numbers following each criterion item represent a scale or continuum. The extremes of each scale have been identified for your use in making this choice. Circle the number which represents your judgment of the degree to which the film satisfies each criterion.

The film was produced for use in an introductory college physics course. The target audience consisted of second-semester freshmen majoring in engineering or physics.

PLEASE DO NOT OMIT ANY ITEMS

1. Are the objectives of the film clear?
   Ambiguous — Clear
   1 2 3 4 5 6

2. Will the film attract and hold the interest of the target audience?
   Dull and boring — Very interesting
   1 2 3 4 5 6

3. Does the film build on previous knowledge, skills, or experience of the target audience?
   No relation to and use of previous knowledge and training — Integrates film content and previous experience very effectively
   1 2 3 4 5 6

4. Does the content relate directly to the main objectives of the film?
   Unrelated — Clearly related
   1 2 3 4 5 6

5. Is the content presented in a well organized, systematic pattern?
   Confused and disorganized — Very well organized
   1 2 3 4 5 6

6. Are the important ideas or procedures clearly emphasized?
   Very vague — Stand out clearly
   1 2 3 4 5 6

7. Does the film attempt to present too much material for the intended audience to learn?

Film tends to cover too many points				Film presents a learnable amount of information	
1	2	3	4	5	6

8. Are new facts, ideas, terminology or procedures introduced at a rate which will permit learning by the target audience?

Poor rate of development: either too fast or too slow				Greater rate of development: neither too fast nor too slow	
1	2	3	4	5	6

9. Does the film provide for adequate repetition of the important content? (e.g., repetition with variation, exact repetition summaries, outlines, etc.)

Repetition is never used or is used excessively				Repetition is used effectively where appropriate	
1	2	3	4	5	6

10. Is the difficulty of the pictorial presentation appropriate considering the characteristics of the target audience? (e.g., age, education level, intelligence, etc.)

Very inappropriate: either too difficult or too easy				Very appropriate: neither too difficult nor too easy	
1	2	3	4	5	6

11. Are the details of the information or demonstration clearly presented pictorially? (This refers to camera angles, lighting, sharpness, exposure, use of closeups, and other technical considerations.)

Presentation is obscure or confusing				Presentation is very clear	
1	2	3	4	5	6

12. Is the verbal difficulty of the commentary appropriate to the age, educational level, and previous experience of the target audience?

Very inappropriate: either too difficult or too easy				Very appropriate: neither too difficult nor too easy	
1	2	3	4	5	6

13. Does the commentator contribute to the effectiveness of this film? (i.e., appearance of commentator, tone of voice, manner of speech, speed of delivery, etc.)

Detracts					Contributes
1	2	3	4	5	6

14. Is the sound track clearly audible?

Sound inaudible					Sound clearly audible
1	2	3	4	5	6

15. Is the information presented in the commentary well integrated with that presented in the pictures?

No integration					Closely integrated
1	2	3	4	5	6

Table 73

Summaries of Analyses of Variance Testing the Effects of Fatigue and Different Sessions on Film Effectiveness Ratings

Source	SS	df	MS	F	
Between Judges	581.17	5			
Specialist groups (A)	193.39	1			
Specialists within groups	387.78	4			
Within Judges	95.33	12			
Repetition of film #3 within first session (B)	3.00	2	1.50	.20	NS
AB	33.44	2	16.72	2.27	NS
B X Specialists within groups	58.89	8	7.36		

Source	SS	df	MS	F	
Between Judges	428.75	5			
Specialist groups (A)	14.08	1			
Specialists within groups	414.67	4			
Within Judges	39.50	6			
Repetition of film #19 between two sessions (B)	2.08	1	2.08	.22	NS
AB	.08	1	.08	.01	NS
B X Specialists within groups	37.33	4	9.33		

NS = Not statistically significant

Table 74

Summaries of Analyses of Variance Determining Inter-rater Reliability Among Film Specialists and Physics Specialists

Film Specialists

Source	SS	df	MS	F	
Between Films	1991.23	18	110.62		
Within Films	908.67	38			
Judges	41.79	2	20.89	.87	NS
Residual	866.88	36	24.08		

$$r_k = \frac{MS_{\text{between films}} - MS_{\text{residual}}}{MS_{\text{between films}}} = .78$$

Physics Specialists

Source	SS	df	MS	F
Between Films	1775.54	18	98.64	
Within Films	2657.33	38		
Judges	1332.25	2	666.12	18.10**
Residual	1325.09	36	36.81	

$$r_k = \frac{MS_{\text{between films}} - MS_{\text{residual}}}{MS_{\text{between films}}} = .63$$

NS = Not statistically significant
** = Significant at the .01 level
r_k = Coefficient of reliability for average ratings

Table 75

Initial, Unrotated Factor Loadings for First Seven Factors - Study Two

	Factors						
Variable	I	II	III	IV	V	VI	VII...
T1	-.78	-.17	.18	-.28	.09	-.23	-.13
T2	-.28	-.53	.22	.10	.43	.30	-.06
T3	-.11	-.51	-.38	-.25	-.11	.10	.08
A4	.50	-.34	-.15	.18	-.19	.07	.40
A5	.48	.55	.31	-.16	-.04	-.17	.02
A6	.00	.35	.06	.03	.20	-.57	.44
A7	.21	.39	.43	.35	-.03	.25	-.25
A8	.56	-.14	.26	-.01	.33	-.11	-.11
A9	.22	.49	-.18	.06	-.25	.57	-.01
A10	.36	-.39	.33	.32	.24	-.21	-.12
V11	-.56	-.16	.08	.09	-.40	-.04	.26
V12	-.71	.09	-.33	-.14	-.24	-.26	-.09
V13	-.48	.18	.13	-.22	.59	.13	-.07
V14	-.32	.23	-.50	-.17	-.33	-.13	-.26
V15	-.53	-.05	-.36	.24	-.33	-.11	.24
V16	-.52	.49	-.27	-.02	.41	.05	-.15
V17	-.23	.58	.32	.03	.23	-.40	.13
V18	.35	.46	-.36	.28	.13	-.16	-.21
V19	-.11	.55	.58	.00	-.07	-.13	-.14
V20	-.72	-.50	.14	-.01	-.21	.05	-.16
AV21	-.08	.54	.17	-.51	.08	.03	.35
AV22	-.31	-.34	.15	.68	-.03	-.33	.22
AV23	.05	-.55	.15	.72	.07	-.16	-.05
AV24	-.03	-.54	.31	-.22	.30	.34	.15
AV25	-.30	-.42	.37	-.37	-.49	-.13	.02
AV26	.30	-.37	.27	-.53	-.04	-.10	.36
SA-60	.12	-.39	.11	-.49	.22	.19	.13
SA-61	.20	.18	.42	-.38	-.30	-.32	-.17
EJ-P	.05	.20	.40	.36	-.22	.16	.43
EJ-F	.62	.42	-.21	.02	-.30	.25	.31
OP-61	-.72	.40	.25	.25	.09	.29	.14
PXIF'	.67	-.32	.11	-.11	-.35	-.17	-.36
PUFL'	-.59	.32	.46	.14	-.26	.34	.01
PXEF'	.02	.02	.53	.04	-.54	.16	-.29

Table 76

Transformation Matrix for Rotation of Factor Loadings - Study Two

Factor	I	II	III	IV	V	VI
I	.42	-.58	-.30	-.05	-.12	.00
II	-.18	.22	-.36	.35	-.44	.32
III	.53	.15	.53	.65	.10	.27
IV	-.07	-.06	-.47	.41	.78	-.01
V	.65	.71	-.49	-.28	.08	.17
VI	.27	.30	-.20	.45	-.42	-.89